Vol. 45 JULY, 1951 No. 1

NATIONAL FIRE PROTECTION ASSOCIATION

Quarterly

Published Quarterly at Boston, Mass., by the
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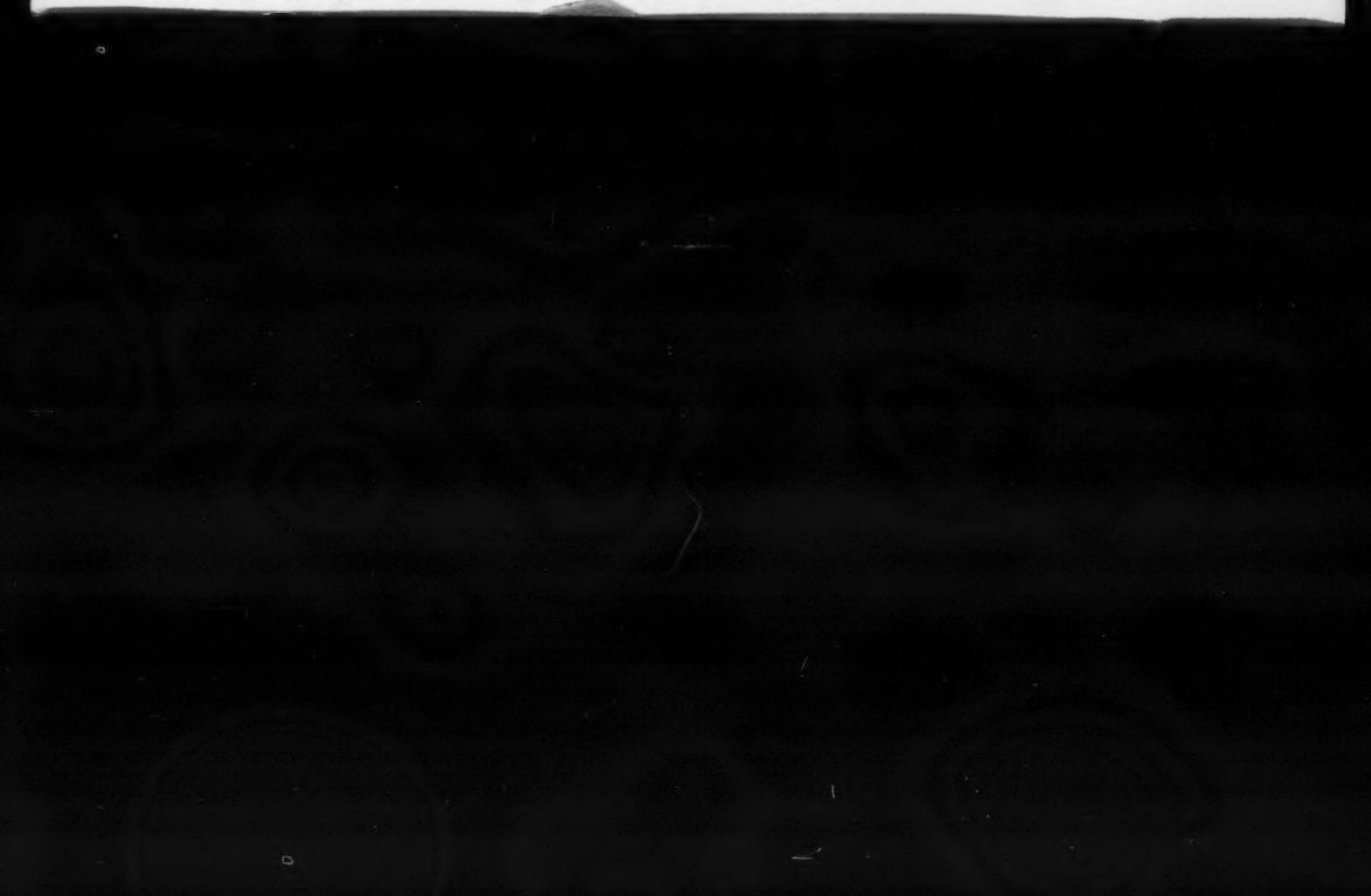

National Fire Protection Association
INTERNATIONAL

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The non-profit, technical and educational membership organization devoted to reduction of loss of life and property by fire. More than 13,000 members.

•

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QUARTERLY
of the
NATIONAL FIRE PROTECTION ASSOCIATION
60 Batterymarch Street, Boston 10, Mass., U. S. A.

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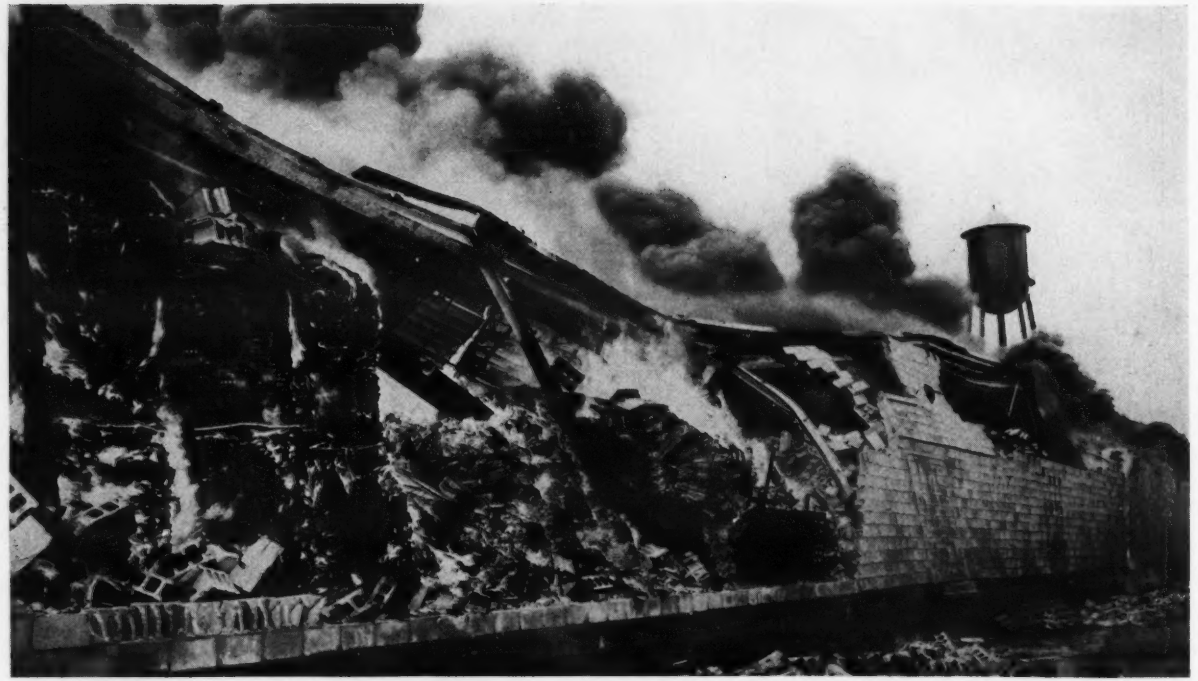

Careless welding was responsible for this $2,000,000 warehouse fire at Hutchinson, Minnesota, April 24, 1951. The sprinkler system for the 65,000 sq. ft. 1-story noncombustible building had been partially dismantled during construction of a refrigerator room. The fire started in the unsprinklered area when sparks from a welding torch being used to tack ceiling hangers to steel joists ignited paper placed on the floor to catch tar drippings. Although first aid extinguishers had been provided and an uncharged hose had been run from a hydrant prior to welding, the smoky fire quickly spread through congested stock, lumber, cork and tar pots and drove everyone from the building. Sprinklers in adjacent areas held the fire in check until the water supply was depleted.

The Quarterly

Vol. 45 **July, 1951** **No. 1**

Meetings of Board of Directors

Detroit, May 7, 1951

Present

A. H. S. Stead, President
Allen L. Cobb, Vice-President
T. Seddon Duke, Vice-President
John L. Wilds, Past President
Richard E. Vernor, Chairman

John H. Alderson
A. L. Brown
Hylton R. Brown
Loren S. Bush
J. E. Frederickson
Leonard C. Lund
R. D. MacDaniel
John A. Neale
Harry E. Newell
Geo. J. Richardson
W. A. Ross
R. C. Sogge

Percy Bugbee, General Manager
Robert S. Moulton, Technical Secretary

Business Transacted

1. The report of the Chairman of the Board of Directors to the annual meeting was read and approved for presentation (text to be published in NFPA Proceedings).

2. The report of the Treasurer was read and approved for presentation to the annual meeting (text to be printed in NFPA Proceedings).

3. It was voted to recommend to the annual meeting the election of H. E. Newell as an honorary life member of the Association.

4. It was voted to present a Certificate of Appreciation to the American Hospital Association in recognition of their work in the field of life safety in hospitals and in recognition of their outstanding cooperation with the National Fire Protection Association.

5. The resignation of Mr. Harold L. Miner as Chairman of the Committee on Flammable Liquids was accepted and Mr. H. E. Newell was appointed Chairman.

6. Mr. H. H. Watson was appointed to membership in the Electrical Correlating Committee to fill the vacancy caused by the resignation of Mr. Frank Thornton, Jr.

7. The appointment of Dr. Charles Goetz as Chairman of the Committee on Carbon Dioxide was confirmed.

8. The term of Hylton R. Brown as a member of the Committee on Technical Committee Procedure was continued to the next meeting of the Board.

9. It was voted to hold the next meeting of the Board at the Hotel Statler, Boston, on Monday, June 25.

10. Messrs. Hylton Brown and Allen Cobb discussed the form of the membership list appearing in the NFPA Year Book and requested that this matter be placed on the agenda of the next Board meeting.

11. Mr. Ross requested that the subject of possible change in the NFPA name to indicate its international character be placed on the agenda of the next Board meeting.

Boston, Mass., June 25, 1951

Present

Richard E. Vernor, Chairman
A. H. S. Stead, President
Allen L. Cobb, Vice-President
T. Seddon Duke, Vice-President
C. W. Pierce, Past President

Donald C. Bowersock	R. D. MacDaniel
A. L. Brown	John A. Neale
Charles H. Bunn, Jr.	H. E. Newell
John Kidde	Geo. J. Richardson
Leonard C. Lund	W. W. Sampson

Percy Bugbee, General Manager; Charles S. Morgan, Assistant General Manager; Robert S. Moulton, Technical Secretary; Horatio Bond, Chief Engineer; George H. Tryon, III, Assistant Technical Secretary; H. E. C. Rainey, Chairman, Membership Committee.

Business Transacted

1. The following officers were elected in accordance with the recommendations voted by the annual meeting: President, A. H. S. Stead; Vice-President, Allen L. Cobb; Vice-President, T. Seddon Duke; Secretary-Treasurer, Hovey T. Freeman; Chairman, Board of Directors, Richard E. Vernor.

2. The Advisory Committee for 1951-52 was appointed as follows: Richard E. Vernor, Chairman, A. H. S. Stead, Allen L. Cobb, T. Seddon Duke, Hovey T. Freeman.

3. Leonard C. Lund and R. C. Sogge were selected to complete the Nominating Committee for 1952.

4. General Manager Bugbee reported on arrangements for the 1952 annual meeting in New York City June 9-13; the plans as presented were approved. Mr. Bugbee also reported tentative arrangements to hold the 1953 annual meeting at the Palmer House in Chicago, May 11-15, to meet in Washington or Philadelphia in 1954, Cincinnati in 1955, Boston in 1956, and Los Angeles in 1957. He was authorized to proceed with tentative arrangements, subject to further action by the Board at subsequent meetings.

5. The Program Committee for the 1952 annual meeting was appointed as follows: the President, the Chairman of the Board, John A. Neale, and the General Manager.

6. The report of the Treasurer, Hovey T. Freeman, was presented by Mr. Bugbee, reflecting a favorable financial condition and showing a balance for the last fiscal year's operation in the final audited figures as compared with a slight deficit shown by preliminary estimates. This report was accepted. (Complete details of the financial report will be published in the NFPA Proceedings 1951).

Special Projects

7. Financial reports on special projects were presented and discussed as follows:

(a) Mr. Bugbee presented the report of the electrical field service project showing an excess of expenses over receipts for the past fiscal year. He reported that contributors to this project had agreed to increase their contributions to a total of $18,000 to provide funds for pension plan payments on account of the electrical field engineer and for other expenses. Mr. Bugbee reported that the NFPA auditors had questioned this project as compared with other special projects in that no account has been taken of the overhead expenses of administering the project. Mr. Bugbee indicated that this situation would be brought to the attention of the Electrical Field Service Committee and expressed the hope that additional funds might be secured to make this project fully self-sustaining and to make proper allowance for overhead expense on the same basis as other special NFPA projects.

(b) Mr. Moulton reported the successful inauguration of the flammable liquids field service project. Mr. Bunn, speaking as Chairman of the Flammable Liquids Field Service Committee, reported general satisfaction with the work of the Flammable Liquids Field Engineer, but on behalf of the American Petroleum Institute indicated that the conditions of the oil industry contribution to this project had not been fully

met. After discussion, it was agreed that appropriate adjustments would be made to meet the American Petroleum Institute criticism.

(c) A proposed new NFPA field service project on gases was discussed by Mr. Moulton, Past President Curtis W. Pierce, H. E. Newell, Chairman of the NFPA Committee on Gases, and others, with particular reference as to whether this should be inaugurated as a separate project or combined with the flammable liquids field service project. The project was approved in principle. The details of its organization were referred to the Committee on Technical Committee Procedure, which is to report to the Advisory Committee with power.

(d) Mr. Moulton, speaking as Secretary of the Society of Fire Protection Engineers, reported a deficit of $981.50 in the operations of the Society for the fiscal year ended April 30 and transmitted the request of the Executive Committee of the Society that the Board of Directors authorize the charging of this amount to general NFPA expenses. It was accordingly voted to charge this amount to general NFPA expense. Subsequent discussion indicated the probability that future operations of the Society would be self-sustaining.

(e) Mr. Bugbee reported the successful operation of the Advertising Council project, indicating the very favorable response which this project has received, stating that contributions would in all probability be available for the coming fiscal year on at least the present basis. He indicated that there was an excess of expense over receipts for this project of $4,700 which, however, was a much smaller net expense than had been anticipated when this project was authorized by the Board. Discussion indicated general approval of this project and the expectation that it could be continued on an expanded basis.

8. The budget for 1951-52 as presented by the Finance Committee was approved.

9. Mr. Moulton reported plans for regional meetings in the fall of 1951 at Portland, Ore., Oct. 23-24, and in Los Angeles on October 29 and 30. These plans were approved and the NFPA Executive Office was authorized to proceed accordingly. Mr. Moulton also reported tentative arrangements for regional meetings in the fall of 1952, one to be held in Houston, Texas, and the other in Cleveland or some other middle western city.

10. General Manager Bugbee reported on the Sponsors Committee as follows:

Sponsors Committee

Since 1924 we have had a Sponsors Committee composed of leaders of American industry. Our annual appeals for financial support are made by this committee over the signature of the Chairman, Mr. Henry D. Sharpe, President of Brown & Sharpe Co. of Providence.

During the past year two members of the committee, Mr. W. B. Bell, President of the American Cyanamid Company, and Mr. Lewis H. Brown, President of Johns-Manville Corporation, have passed away. Mr. Walter Gifford, former President of American Telephone & Telegraph Company, is now Ambassador to England.

In order to keep the strength of the committee, we have secured the consent of the following men to serve:

E. S. Farrow, Vice-President, Eastman Kodak Co.

Alfred T. Glassett, President, W. J. Barney Corp.

P. F. Lavedan, President, The Liquid Carbonic Corp.

Neil McElroy, President, The Proctor & Gamble Co.

G. Metzman, President, New York Central System.

11. A proposal by Board member John Kidde that the service of Board members be limited to two consecutive terms was discussed and referred to the Advisory Committee for further consideration and report to the Board at a subsequent meeting.

12. In accordance with a recommendation by a special committee consisting of Allen L. Cobb, Chairman, Hylton Brown and John A. Neale, it was voted that a medal and accompanying certificate to be known as the National Fire Protection Association Distinguished Service Award be provided by the Association and given upon authorization by the Board of Directors to a member or members in recognition of some outstanding contribution to fire protection.

13. A proposal by former Board member Ross that the name of the Association be changed to indicate more clearly its international character was discussed and it was voted to make no change in the NFPA name.

14. A proposal to modify the form of the NFPA Year Book to include alphabetical listing of members was discussed without action. The discussion indicated that the possible benefits of the proposal would not be commensurate with the heavy expense that would be involved.

Other Committee Actions

15. The report of the Committee on Technical Committee Procedure presented by Chairman A. L. Brown was approved, including action on various items as follows:

(a) *Committee on Magnesium.* It was voted to change the name of this committee to "Committee on Combustible Metals" and to revise the scope statement by substituting "magnesium and other combustible metals" for "magnesium and its alloys."

(b) *Dry Chemical Extinguishing Systems.* It was voted to create a new NFPA Committee on Dry Chemical Extinguishing Systems to report to the Association through the General Committee on Special Extinguishing Methods and the personnel for the new committee was approved as recommended by the Committee on Technical Committee Procedure. (The personnel will be published in the NFPA Year Book 1951.)

(c) *Committee on Aircraft Hangars.* A new Committee on Aircraft Hangars was created, this committee to report to the Association through the NFPA Committee on Aviation and Airport Fire Protection, Executive Division. The personnel of this committee as recommended by the Committee on Technical Committee Procedure was approved including liaison representation of other NFPA committees. (The personnel will be published in the NFPA Year Book 1951.)

(d) *Hospital Operating Rooms.* It was voted to enlarge the scope of the Committee on Hospital Operating Rooms to permit this committee to consider additional subjects, the revised scope statement to read:

> "Develops standards on hospital operating rooms, medical gases and related subjects. Reports of the committee pertaining to gases require concurrence of the Committee on Gases; on subjects within the jurisdiction of other NFPA committees the concurrence of the appropriate other committee."

(e) *Fire Protection Engineering Education.* It was voted to discharge the NFPA Committee on Fire Protection Engineering Education (inactive since before the war) and to request the Society of Fire Protection Engineers (an NFPA Section) to proceed with appropriate measures for the promotion of fire protection engineering education.

(f) *Forest Committee.* A revised scope statement for this committee was voted as follows:

> "This committee functions in both a technical and educational capacity in active cooperation with the U. S. Forest Service and the Dominion Forest Service. Its work includes the various phases of prevention and control of forest, grass, and brush fires. This includes training, organization, and research embracing planning and development of forest fire protection techniques."

(g) Appointments to technical committees were confirmed in accordance with the list of proposed appointments submitted to the Board members with the agenda, also a supplementary list presented at the Board meeting. It was also voted to authorize the Committee on Technical Committee Procedure to make additional committee appointments prior to the publication of the 1951 Year Book, subject to confirmation by the Board at its next meeting and to reappoint all present members of technical committees for the Association year 1951-52 with the exception of those who have resigned or have been replaced. (The complete list of committees will appear in the NFPA Year Book for 1951.)

16. The Committee on Technical Committee Procedure for 1951-52 was appointed, to serve until the summer 1952 meeting of the Board as follows: A. L. Brown, Chairman, Hylton R. Brown, A. L. Cobb, H. E. Newell, R. C. Sogge.

Revision of NFPA Standard No. 51

17. A revision in Par. 36(b) of the Standards on Gas Systems for Welding and Cutting (NFPA No. 51) was adopted in the name of the Association in accordance with the recommendation of the

Committee on Gases presented by Chairman H. E. Newell, all in accordance with the authorization of the 1951 annual meeting. Chairman Newell reported the committee ballot on this proposal as follows: 21 affirmative, 1 affirmative with reservation, 1 negative, Messrs. E. J. Smith and A. G. Smith retired and not voting. It was voted to express the Board's official appreciation of the past services of Messrs. E. J. Smith and A. G. Smith to be duly communicated to them. The revised text of Par. 36(b) adopted is as follows:

> "36(b) A single hose having more than one gas passage, a wall failure of which would permit the flow of one gas into the other gas passage, shall not be permitted. However, hoses joined by a web so as to form integral lengths of double hose are acceptable provided that the hoses are easily distinguishable from each other. Identification of the two hoses for gas passages shall be as follows: (1) By exterior color, such as by employing green for oxygen and red for acetylene, *or* (2) If the entire exterior of both passages is of the same color and the two sides are distinguishable by feel or touch (*i.e.,* smooth versus ribbed or rough exterior surface), the oxygen side shall bear labels with the word 'oxygen' placed at intervals not greater than 15 feet, *or* (3) If the entire exterior of both passages is of the same color and not distinguishable by feel or touch, then the oxygen side shall be labeled with the word 'oxygen' at intervals of not more than 6 feet."

18. It was voted to hold the next meeting of the Board in New York City on January 25, 1952.

19. Past President Curtis W. Pierce made various suggestions for the future consideration of the Board, including a broadening of the field of operations of the Association and a larger increase in NFPA membership, the desirability of focusing additional attention on indirect fire losses through the issuance of supplementary reports where appropriate to publicize the many indirect losses incident to major fires, and a suggestion that the work of the NFPA Nominating Committees could be made more effective through the adoption of some uniform and continuing policy for more thorough discussion and consideration of candidates prior to making their report to the Association. All of these suggestions were reviewed, the discussion indicating general concurrence with Mr. Pierce's views as to the desirability of policy matters proposed but without specific action except that it was voted to refer to the Advisory Committee Mr. Pierce's suggestions concerning increase in membership.

20. It was voted to request the General Manager to express to the family of the late NFPA Past President, David J. Price, the condolences of the Board.

21. At a luncheon session attended by the President and Executive Committee of the Society of Fire Protection Engineers and by additional members of the NFPA staff, President John J. Ahern of the Society of Fire Protection Engineers reported the successful inauguration of the Society's activities, reviewed the accomplishments to date, and future plans. Mr. Ahern's report was accepted with expressions of commendation.

Our Soundest Investment*

By the Hon. Luther W. Youngdahl

Governor of the State of Minnesota

It's a wonderful thing and I certainly am inspired to hear your President's report† and thus to realize again the wide scope of the activities of the National Fire Protection Association, to recognize that this organization is having greater international significance as each year goes by. It is a great and wonderful thing that you NFPA members are dedicating and consecrating your lives to the conservation of human life, just at the very moment when there is so much destruction of human life! The tremendous service that has been rendered by the NFPA to our country and to the world in inspiring people to greater efforts in human values and in the strengthening of human resources is certainly worthy of commendation.

Despite all of our efforts, despite all the organizations and the activity, we, as a people, haven't yet learned the lesson of prevention. We haven't yet learned that whatever money we invest in prevention is the soundest kind of economy. We haven't appreciated it even in other fields of activity as much as we should, in the field of medicine, and in flood prevention, for instance. Surely we haven't understood its significance in the field of juvenile delinquency. We have spent so much of our money in sending our youngsters to reformatories and penitentiaries instead of learning the significance of prevention and how it really pays and enables us to reap big dividends.

I think of that test that was given in an institution for the mentally impaired. The sick person was placed beside an empty tub which was placed underneath the running tap of water and an empty pail was placed beside the tub. The sick person was told to empty the tub. If he started to bail out the water without paying any attention to the tap, the source of supply, it was concluded that he didn't quite have the judgment and discretion to warrant his release from that mental hospital, but if he first turned off the tap, the source of supply, and then started to bail out the water, it was decided that that sick person had enough discretion and judgment to warrant his release from the institution. I think we can quickly draw the analogy here in this fire activity. We have paid too much attention to putting out the fires and only now do we realize that the Fire Prevention Bureau of the Fire Department is the most important activity of all.

Most of the deaths from fire occur in the home, yet city fire departments often do not have either the facilities or the personnel to make proper home inspections. Those who have had control of the purse strings haven't understood that it is common sense economy to furnish these inspectors. One answer to this problem is the establishment of a "Junior Firemen"

*Presented as an address to the 55th Annual Meeting of NFPA, May 9, 1951. (Program Item No. 25.)

†See NFPA Proceedings of the Fifty-fifth Annual Meeting.

organization. In Minneapolis, for instance, "Junior Firemen" are taught to make careful inspections for fire hazards in the home, and, under the leadership of the Minneapolis Fire Department, in cooperation with the Health and Safety Divisions of the public and parochial schools of our metropolitan area, these youngsters receive invaluable training. It teaches them responsibility. After all, this matter of the protection of human life is a matter of personal responsibility and we are going to secure it only by acceptance of this responsibility.

We are too smug about this thing. We read about some tragic fire in a school, on a farm, in a hospital or in a home. "But it can't possibly affect us," we say. And suddenly we wake up to the stark, disillusioning fact that it does affect us. It affects every one of us, and only by the acceptance of personal responsibility will we make a dent in this problem.

Shut your eyes, put your finger on the map, country, city, rich district, poor district, million-dollar edifice or a one-room schoolhouse. It makes no difference. Fire cuts across all lines. The chances are better than one out of two that death has been built into that structure and that the people in charge don't know it or minimize it or deny it or aggravate it, possibly, by their own helplessness or ignorance of what makes a fire.

Amy Porter,* after visiting schools at random in six states, reports that inexcusable fire hazards exist in some of the schools of virtually every community. She states that: "fire experts keep pointing out that school fires are on the increase, that there was an average of five fires in schoolhouses daily in 1937 and now the average is 7 daily." One of your experts taking part in this program, Mr. Alfred Fleming, is quoted in this article as saying "that the only reason we do not have more frequent wholesale slaughter in school fires is the whimsical fact that four-fifths of these fires originate when the schools are not in session."

Out of the ancient Talmud there comes the tale of a dream, a dream of Justice standing with a large pair of scales in her hand. On one side of the scales is located silver and gold and land and lumber and buildings. That side of the scale weighs to the earth. On the other side of the scale is a nest of straw that tips to the heavens. In his dream, the king sees a guardian angel robed in white approach that nest of straw and place therein a little child. Gradually that side of the scale weighs to the earth and the king says to himself, "That proves that the child is the most important thing on earth."

Yes, more important than silver and gold and land and lumber and buildings! That is something for us to remember, isn't it? When we say we haven't got the money to provide a fire escape; when we say that we haven't got the money to provide decent and safe school buildings and hospitals and other structures, that is something for us to pause and think about.

As has been suggested, if we really believe that children are our nation's most valuable asset, they should be worth working for and fighting for and paying for and dying for. No child should die because his parents failed to provide a fire-safe home. No child should die because he lives in a community which has inadequate fire protection or none at all. No child

*See "Death in the Classroom." *Collier's* Magazine, Oct. 2, 1948, Vol. 122, No. 14 and Oct. 9, 1948, Vol. 122, No. 15.

should die because his parents violate all of the safety rules in kindling fires. No child should die because fire regulations have not been enforced with respect to building safety. No child should die because his teachers have failed to give him an opportunity to protect himself from fire by knowing what to do and by having some practice in the doing of it.

An up-to-date fire department, with particular stress on fire prevention work, is one of the community's soundest investments. No community can afford a bad fire department and we cannot afford to say that we haven't got the money to provide a good fire department. As to whether we have the money or not depends upon one's sense of values. We do have the money to spend twenty billions of dollars each year in the gambling rackets of the United States. We don't seem to have any difficulty in finding the money when we are building a reformatory or a penitentiary. We don't have much difficulty finding the money to build a battleship or an aircraft carrier. It all depends upon one's sense of values as to whether we have the money or not. And besides, I want to repeat and re-emphasize — it is economy. It is not spending, it is investing.

The battle that you people are engaged in is the battle of dollars versus human lives and, after all, the whole philosophy underlying this fire prevention activity is the very basic philosophy that underlies the ideological struggle that is involved in this world conflict today, giving dignity to and having reverence for the sacredness of human life. Every life is worth saving. Every single individual is worth saving, regardless of his nationality or his religious convictions or his political beliefs. Every single individual is a human personality, created in the image of God.

You of the NFPA must feel awfully good because you are engaged in an activity to help people to live, to conserve the most precious thing that we have got, human life itself.

We see the cleavage, the contrasting picture between our way of life and the Communistic way in that basic philosophy. It is not always as easy for us to understand the discipline and the sacrifices that are necessary for us to undergo in order to maintain this way of life of ours. A great general, General Bradley, suggests that it is not the number of dollars we have in the bank that determines the character of our people, but it is the willingness of our people to forego some of the things for themselves in order to provide a better way of life for all.

We have commenced to appreciate, maybe, after all, that there is something to that philosophy. I surely saw the difference, the cleavage, at the World Freedom Bell ceremony on the 24th of October last. On United Nations Day I stood on the platform in the Western Sector of Berlin; 400,000 German people were there and pledged themselves with us to pay whatever price was necessary for freedom. At 3 minutes past twelve that great World's Freedom Bell poured forth its message, forged, in the same place where the great Liberty Bell was forged, with paraphrased words upon it from Lincoln's address, that "This world, under God, shall have a new birth of freedom." As we stood there and joined hands together, agreeing to pay whatever price was necessary, we all understood that there was no alternative, that it was either/or. We remembered one of the Fables of Æsop, of the lion and the goat standing at the water hole quarreling with each other as to which should drink first and the vultures were wheeling low over-

head ready to pick the bones, and the lion and the goat decided they had better get together and drink together or the vultures would pick both their bones.

Well, you know, the vultures are wheeling overhead today, ready to pick our bones, and all the dollars in the bank and all our stocks and bonds and all of our farms and our rich fertile soil and our material resources aren't going to avail us anything unless we get together and work together and struggle together and pay whatever price has to be paid for the perpetuation of the most precious thing that we have got, our freedom and life itself.

On the morning of the 25th of October, I had occasion to travel over into the Eastern sector of Berlin by special permission of General Taylor, and there surely I saw the difference between hope and despair, between life and death, between democracy and communism, for there I saw almost 2,000,000 German people under the iron heel of the dictator in abject slavery. They knew, those German people knew, whatever price one had to pay for freedom, surely it was worth it, rather than the stark alternative which they were facing there.

You remember the great wall of China, overcome by the corruption of the gatekeepers. The same thing can happen to the United States, with all of her vaunted strength, with all of her material resources. The greatest enemy we have today, in my humble opinion, comes from within. The moral decay, the lack of unity, the failure to discipline, the failure to place first things first, the lack of decent spiritual values, will destroy us from within much more quickly than we will be destroyed from without. Smugness and complacency in thinking, that because we had freedom yesterday and we have got it today, we are going to have it tomorrow.

That isn't the story of history. We are not going to have it tomorrow unless we pay the price for it.

Maybe you don't know what freedom means to you and to me. Let's think of what Hazel Parker said about the meaning of freedom. It is a good thing to recall it to our minds now as our boys are dying for it in the battlefields of Korea. Hazel Parker said that "Freedom is a man opening a gate latch at night and sitting for a while on his porch smoking his pipe before he goes to bed. It is the violence of an election argument outside of an election booth. It is the righteous anger of pulpits. It is the warm laughter of a girl on a park bench. It is Westbrook Pegler telling Roosevelt how to raise his children. It is Roosevelt letting them raise themselves. It is the unafraid faces of people looking out the windows of a train as it speeds across the continent. It is Lindbergh's appeasing voice raised above a thousand hisses. It is Dorothy Thompson asking for war. It is Hugh Johnson asking her to keep quiet. It is the shoulders of a mountain supporting the sky; the seas breaking over the white sand somewhere; the air you breathe and the dirt that is in your garden. It is a man cursing all cops. It is you trying to remember the words of 'The Star Spangled Banner.' It is a lack of apprehensiveness at the sound of approaching footsteps outside your door. It is all the things you feel and cannot help feeling. Freedom! It is you, and you, and you. It is I. And just as freedom hits each one of us, just so do we determine whether we are going to continue to enjoy freedom or not."

When I was helping to sell Liberty Bonds in the last war, I remember the

poster we had to assist us. Illustrative of the philosophy, it showed a man dying on the battlefield and the words at the top were, "He died today for Freedom." And the words at the bottom were, "What are YOU doing?" Today? For freedom? Not tomorrow or next month. Today. Making the most out of each day's opportunities to conserve human values.

I needn't ask you that question. By your membership in the National Fire Protection Association, by all the efforts to safeguard life and property from fire that you have put forth, you surely are doing something today for freedom.

Fellow citizens, we are standing at the crossroads. We can either travel down that old road of fire — and surely it was a road of fire at Hiroshima and Nagasaki. It is going to be precisely that, to a more accentuated degree, in World War III. Or we can choose the other road. It is not going to be very easy; we are not going to be able to have our cake and eat it too; it is the old story of discipline and sacrifice through rugged decisiveness of character that is going to count. God grant that we will make the right choice!

Theory of Fire Hazard Relativity*

By Chester I. Babcock

Manager, NFPA Fire Record Department

In our opinion there is no subject more worthy of careful attention by those responsible for plant fire safety than the record of serious industrial fires that are occurring with increasing frequency in the United States and Canada. A year ago we were able to report a 27% decrease in the number of large loss industrial fires in 1949 as compared with 1948. At that time we wondered whether half measures, disinterest and lip service to fire protection were at last being supplanted by well rounded programs of fire safety. We dared to hope so — but the record of 1950 showed that our hopes were ill-founded and premature! There were 24 percent more industrial fires in the United States and Canada in 1950 with loss of $250,000 or more than in 1949, and if the record of the first quarter of 1951 continues throughout the year, this year will exceed 1948, the worst on record.

So much for the record. What suggestions can we make to plant fire safety supervisors to assist them in their efforts to protect their properties from fires such as these? One suggestion that I can make without any hesitancy is that they study carefully the reports of large industrial fires — all industrial fires, not just those identified by their occupancy class as being similar. For, after all, the whole science of fire protection is based on a knowledge of fire behavior under varied conditions and what better place to learn this behavior than from actual fire experience (preferably not your own)!

There are three things a good fire protection engineer should know that a study

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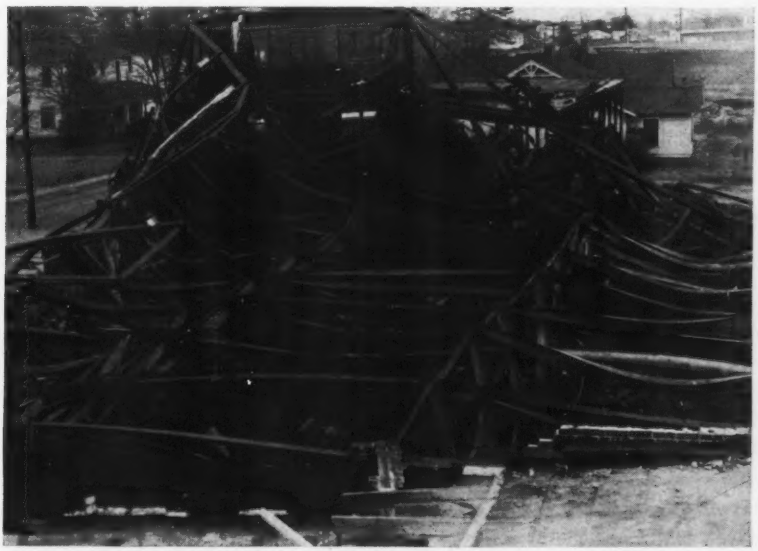
of large industrial fires will give him. First, he must be able to recognize specific hazardous conditions; second, he must be able to evaluate how human acts may affect those specific hazards; and, third, he must be able to appreciate the relationship of one particular condition to other fire protection weaknesses. It is well known that serious fires are usually not due to one particular fire protection weakness but are the end result of a combination of factors, each one of which makes a vital contribution to the spread of fire. Analyses of large loss fires, such as those published in the January NFPA *Quarterlies,* give clear indication of what fire protection and human weaknesses are the most frequently encountered in large industrial fires, but in order to best appreciate the interrelationship of contributing factors, or as we might call it *the theory of fire hazard relativity,* it is helpful to study case histories.

To explain more fully this *theory of fire hazard relativity* I would like to review with you three large industrial fires that have occurred this year. These fires have been chosen at random. Others would serve equally well.

First Example

Let's look first at a 14,500 sq. ft. 3-story masonry-walled, steel-framed plant at Hickory, North Carolina, occupied by a manufacturer of chair and bed springs. Had a fire protection engineer made a survey of this plant on February 14 these are some of the weaknesses in its fire safety he would have noted: (1) that the building was unsprinklered and floor areas were not subdivided; (2) that employees smoked while working; (3) that the watchman was not aware of the presence of a fire alarm box outside the building; (4) that



Ruins of a chair and bedspring manufacturing plant at Hickory, N. C. after fire of February 14, 1951. Eleven fire protection weaknesses contributed to this $500,000 loss.

kerosene-soaked sawdust was allowed to collect on the floor; (5) he would learn that it was the custom in this plant to lubricate wire entering spring coiling machines by drawing the wire through a handful of kerosene-soaked waste and that the sawdust was provided to collect the drippings; (6) he would notice that the ceiling of the first story was saturated with some sort of liquid that apparently came from the second story; (7) on his way to the second story to investigate this condition further, he would note that the stairway and elevator shafts were open; (8) in the second story he would find several dip tanks without covers, each containing from 30 to 50 gallons of highly flammable enamel; (9) he would have noticed that this second floor was saturated with enamel that had overflowed the tanks and dropped from springs as they were carried to gas-fired ovens, this last condition undoubtedly accounting for the liquid-soaked first story ceiling; (10) in inspecting the ovens he would have checked the manual shut-off valves on the 2-inch supply main and discovered that there was no outside shut-off provided, the only valve being inside the building on the first floor; (11) finally, he would have noted that an 8-inch brick wall separated the plant from an adjoining 1-story sprinklered hosiery mill. He might question the resistance of this wall under fire conditions but would probably decide that since the hosiery mill was sprinklered, the exposure threat to the spring manufacturing plant could be overlooked. It is interesting to note, however, that had the engineer been making a survey of the fire vulnerability of the hosiery mill, he would be justified in doubting whether it was adequately protected against exposure from fire in the unsprinklered spring manufacturing plant.

These are some of the conditions he would have noted. Each was in a sense an isolated, separate problem. However, being familiar with fire behavior, he would have immediately visualized the relationship of these hazardous conditions one to another and, by applying the *theory of fire hazard relativity,* would have realized that through the combined effects of these hazards a fire starting anywhere in the building would be likely to destroy the entire structure, as, in fact, it did later on the same day as this hypothetical inspection.

The fire actually started at 11:00 P.M. on the first floor in the kerosene-soaked sawdust. In the opinion of the owners, the fire was caused by the careless smoking of an employee. It was reported that first aid appliances were provided, but fire spread so rapidly that no attempt was made to use them. Flames ignited the paint-saturated ceiling, spread rapidly across the ceiling to the open stairway and elevator shaft, and up these openings to the second story where dip tanks and paint soaked floors were quickly involved. In the meantime the plant watchman had attempted to give the alarm over the plant telephone and, on finding the line dead, went down the street to use a phone in a pool room, disregarding the fire alarm box near the plant.

Firemen found the building in flames and were unable to enter the first floor to shut the valve on the gas main which had broken and was feeding gas to the fire. Needless to say the building could not be saved and all efforts were directed toward protecting the adjoining hosiery mill. During the fire, part of the 8-inch brick wall separating the two structures collapsed but, through the combined action of sprinklers and hose streams, most of the hosiery mill was saved.

World-Herald

Laundering compounds were manufactured in this Omaha, Nebraska plant. On January 9 fire originating at a gas-fired kettle of mineral oil spread rapidly to upper floors of the unsprinklered building through an open elevator shaft. A fire wall with all openings protected prevented spread to an adjoining 1-story warehouse.

Second Example

Another fire which emphasizes the importance of recognizing the manner in which hazardous conditions can combine to cause disastrous results occurred January 9 at a plant manufacturing laundering compounds at Omaha, Nebraska. Here again, had a fire protection engineer made a survey of the plant he undoubtedly would have visualized the distinct possibility of a serious fire, although it must be admitted that some of the hazardous conditions were not so evident as at Hickory, North Carolina.

This plant was in a 3-story, brick, wood-joisted structure with open finish; 5,500 sq. ft. floor areas were undivided, and stair and elevator shafts were open. No automatic protection was provided and although there appeared to be an ample supply of first aid equipment, at least some of the employees were not familiar with the operation of these devices. Our fire protection engineer would have noted all these points and made a mental note that these factors could combine to make the building subject to total burn-out if fire should start. A 1-story warehouse adjoined and communicated with the manufacturing building but since a 20-inch fire wall with all openings protected by standard fire doors separated the two buildings, the engineer would be justified in minimizing the probability that fire in either building would spread to the other. Of course, his knowledge of past fires in which fire doors blocked open permitted fire to spread through fire walls would not allow him to eliminate completely this possibility.

After noting these structural and fire protection weaknesses our fire protection

engineer would make a careful survey of the so-called occupancy hazards in order to determine the probability of a fire starting. Here he might well have been misled since the ingredients for the various powders and solutions were for the most part noncombustible and the processes nonhazardous. One exception to catch his eye would be a 30-gallon gas-fired kettle of mineral oil which was added in small amounts to a liquid starch mixture to keep it from stratifying while on the retailers' shelves. In order to emulsify the oil properly it was the practice in this plant to warm the oil in the gas-fired kettle to 126°F before mixing.

Although this temperature is well below the 315°F flash point of the oil, our alert engineer would have been aware that cold oil when heated under such conditions is subject to local overheating and run over. He would have much preferred to see the operation conducted in a steam jacketed kettle. Here then was one potential cause of fire. Applying the *theory of fire hazard relativity,* our inspector could see how a fire originating here could spread throughout the plant because of the lack of automatic protection, the unfamiliarity of employees with manual fire extinguishers, the undivided floor areas, and the open stair and elevator shafts. He may well have discovered other potential fire causes and hazardous conditions also, but these are the ones which, through their combined presence, caused the burnout of the building last January 9.

At 8 o'clock in the morning, a Monday, as the plant was opening for the day's operations, an employee lit the gas under the 30-gallon oil kettle to heat the oil which had been standing over the weekend and had become thoroughly cooled. The employee then left the kettle unattended and on his return, less than 5 minutes later, to check the oil temperature, the room in the vicinity of the kettle was ablaze. Although nobody was present to see just what happened it is thought that the oil superheated at the bottom of the kettle, boiled up and around the cold oil in the center, and ran over the rim and down the outside of the kettle and ignited at the gas flame. The employee first tried to use a 4-pound carbon dioxide extinguisher but being excited and unfamiliar with its operation discarded it in favor of a 1½-inch standpipe hose. However, before he could get the kinks out, this too had to be abandoned as flames spread quickly to the adjacent elevator shaft and extended to the second and third stories. Flame spread was so rapid that an employee on the third floor was only able to descend to the second floor where he was obliged to hang by his fingers from a window ledge until rescued. Fortunately, the alarm was telephoned without much delay by an outsider and the employee was soon rescued from his precarious position. The building of origin was badly damaged but due to efficient operation of the fire department and the fact that the fire wall separating the warehouse from the burning structure was well constructed and all openings were protected, the fire was confined to the building of origin and was under control by 9 o'clock—not, however, before $250,000 damage had been done.

Again we see the influence of the interrelationship of fire protection weaknesses. The kettle, the unprotected openings, the lack of automatic protection, the untrained employee; on the positive side, we note our relativity theory also holds true — a properly constructed fire wall, standard fire doors in openings and all doors closed — these protected the warehouse.

Charles R. Conley

An undivided ground floor area of 53,000 sq. ft. was one of nine fire protection weaknesses that through their combined action caused the total destruction of this metalworking plant at Upper Sandusky, Ohio, January 30. Loss is estimated at $3,000,000.

Third Example

Here is one more example taken from the 1951 fire record to show how isolated fire protection weaknesses combine to cause serious fires. One of the largest industrial fires of the year occurred January 30 at Upper Sandusky, Ohio. This plant manufactured gears, hydraulic equipment and other metal parts. Let us suppose that a fire protection engineer had entered this plant on the morning of the fire to evaluate its fire safety. What are some of the conditions he would have noted? First, a 53,000 sq. ft. undivided first floor, communicating with the second story of the 1- and 2-story building through two open stairways and an open elevator shaft; second, the absence of automatic sprinklers; third, that first aid equipment was not in operating condition; fourth, that spray painting was conducted in a small not-cut-off addition (he would have been advised that a fire door had been purchased to cut-off this area but this would not alter his estimate of the fire potential of the plant as far as conditions on that particular morning were concerned); fifth, that metal grinding was conducted in the spray room; sixth, that an open pan of flammable paint thinner was adjacent to the grinding equipment; seventh, that a large quantity of oil used in heat-treating and tempering was present in open containers and drums throughout the plant; eighth, that floors and ceilings were covered with an oily deposit; and ninth, that the only hydrant within reasonable distance of the plant was connected to a 4-inch dead end main.

Once again, here was a combination of factors that made a perfect set-up for a total loss if ever a fire should start! On the NFPA fire report form the fire chief is asked to comment on the attitude of property management toward fire safety. On his report of this fire, Chief Bringman gave the following answer to this question:

"Attitude toward fire safety was very good, but that was as far as it went."

This fire also occurred while the plant was in operation and as in the two previous case histories, ignition of a flammable liquid gave it its start. On the morning of the fire, spray painting was being done in the small not-cut-off addition and in the same area workmen using portable grinders were removing rough spots from castings prior to painting. At 11:00 A.M. an open pan of paint thinner ignited in the paint room, apparently when hot pieces of metal from the grinding operation landed in the thinner. For the first minute or two fire was confined to the vicinity of the pan of thinner and could probably have been extinguished had an extinguisher been discharged on it promptly. This was not to be, however, for when an attempt was made to discharge a carbon dioxide extinguisher on the fire it was found to be empty. Before another extinguisher could be obtained from another part of the building flames were bursting from the spray room into the main plant. Fire spread with great rapidity over the oily interior surfaces, ignited containers of heat treating oils and by the time the town's pumper with one man arrived, flames involved the entire building. The one hose stream that could be supplied from the 4-inch dead end main was useless against the 43,000 sq. ft. of raging fire. Eventually fire departments from surrounding towns were able to lay eight long hose lines to the fire but by then the building was entirely destroyed.

Summary

The prediction was made that on the basis of the fire experience of the first quarter of 1951, this year gives promise of setting a record for bad industrial fires. Between now and December 31 we can expect that hundreds of United States and Canadian industrial plants will be incapacitated, some permanently, by fires such as the three just cited. These serious fires need not occur and many of them will not if those responsible for plant fire safety acquire a better appreciation of the interrelationship of fire hazardous conditions. Looking at the open pan of thinner in the spray room as an isolated fire protection weakness, one might be inclined to underestimate the possibility of extensive fire damage to the Upper Sandusky plant. When, however, this hazardous condition is considered in relation to the lack of sprinklers, the empty fire extinguisher, the unprotected doorway, the oily walls and the open stairways, etc., a more accurate evaluation of the vulnerability of the plant to extensive damage or destruction is possible.

The ability to recognize the interrelationship of individual fire hazards cannot be overemphasized. I urge industrial plant protection supervisors to teach the *theory of fire hazard relativity* to their inspectors and their employees; impress them with its importance, for only when all concerned with the plant safety are aware of the manner in which individual hazards combine to cause serious fires, will the plant fire protection program be adequate.

Television and FM Antennas

By Charles L. Smith*

NFPA Electrical Field Engineer

The rapidly created interest in, and the general acceptance of, the entertainment medium of television by the general public has brought to the attention of fire prevention and safety engineers the necessity of enforcing nationally recognized standards relating to the installation of antenna structures so as to reduce losses of life and property.

The National Electrical Code (NFPA No. 70), which is sponsored by the National Fire Protection Association, provides, in Article 810, radio equipment installation requirements promulgated through the efforts of representatives of electrical and allied industries, fire safety authorities, lightning protection engineers and electrical inspectors. The requirements specified in this Code and the Code for Protection Against Lightning (NFPA No. 78) should be followed to assure that antennas are installed so as to be reasonably free from damage by wind, ice loading, lightning and other hazards.

*In preparing this article, Mr. Smith secured the advice of the following individuals and firms and wishes to acknowledge with appreciation their assistance:

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Underwriters' Laboratories, Inc., K. S. Geiges

The first requirements pertaining to radio equipment appeared in the 1920 edition of the National Electrical Code. The Code has been periodically revised to keep in step with engineering and installation practices. Article 810 of the NEC was revised in 1949 to include radio antennas used for television and FM (frequency-modulation) receivers with the advice of a special committee on antennas of the Radio Manufacturers Association, Engineering Department.

All sections of Article 810 pertain to radio equipment. In this article, we will discuss, however, only those sections dealing specifically with antennas in view of the many questions that have arisen because of the requirements for outdoor antenna installations peculiar to TV and FM receivers. Certain provisions of the Lightning Code and the requirements of the Underwriters' Laboratories, Inc. are also reviewed.

The provisions of Section 8115 of the National Electrical Code state:

8115. STRUCTURES. Metal structures supporting antennas shall be permanently and effectively grounded.

It is the intent of this section to require all metal structures including masts and poles supporting antenna members to be grounded in a specified manner. The installation requirements of the Underwriters' Laboratories, Inc. standards for Master Labeled Lightning Protection Systems require that masts, if of metal, when installed on the outside of the building shall

be bonded to the lightning protection system with standard lightning conductors or the equivalent. The NFPA Lightning Code states, in Section 218 (b) as follows:

(*b*) *Metal Radio Masts on Buildings.*—Metal radio masts on buildings shall be bonded to the nearest lightning conductor.

Grounding Conductors

Requirements for grounding conductors are contained in the following Sections of the National Electrical Code.

Grounding Conductors—General

8151. MATERIAL. The grounding conductor shall, unless otherwise specified, be of copper, aluminum, copper-clad steel, bronze, or other corrosion-resistant material.

8152. INSULATION. The grounding conductors may be uninsulated.

8153. SUPPORTS. The grounding conductors shall be securely fastened in place, and may be directly attached to the surface wired over without the use of insulating supports.

8154. MECHANICAL PROTECTION. The grounding conductor shall be protected where exposed to mechanical injury.

8155. RUN IN STRAIGHT LINE. The grounding conductor shall be run in as straight a line as possible from the antenna mast and/or lightning arrester to the grounding electrode.

8156. GROUNDING ELECTRODE. The grounding conductor shall be connected to a grounding electrode as specified in sections 2581 to 2583 of Article 250.

Grounding Conductors—Receiving Stations

8161. INSIDE OR OUTSIDE BUILDING. The grounding conductor may be run either inside or outside the building.

8162. SIZE OF PROTECTIVE GROUND. The protective grounding conductor for receiving stations shall be not smaller than No. 14 copper or No. 12 aluminum or No. 17 copper-clad steel or bronze, provided that where wholly inside the building it shall not be smaller than No. 18.

8163. COMMON GROUND. A single grounding conductor may be used for both protective and operating purposes.

If a single conductor is so used, the ground terminal of the equipment should be connected to the ground terminal of the protective device.

As noted in the above sections, a suitable grounding conductor must be installed from the metal mast to a grounding electrode. This conductor shall be of a material as specified in Section 8151 and of a size as specified in Section 8162. (Some local ordinances require, and some authorities recommend a minimum size No. 6 AWG, copper or equivalent, grounding conductor for mechanical strength).

As required in Section 213 (i) of the NFPA "Code for Protection Against Lightning" the grounding conductor should be run in as straight a line as possible:

213. AIR TERMINALS AND CONDUCTORS.

* * * *

(*i*) *Bends.*—No bend in a conductor which embraces a portion of a building such as an eave, shall have a radius of less than 8 inches (20.3 cm). The angle of any turn shall not exceed 90° and conductors shall everywhere preserve a downward or approximately horizontal course.

Reference should also be made to Section 8155 of the NEC, quoted above, and to Figure 3 herein.

Sections 2581 to 2583 of the NEC which were noted in Section 8156 follow:

Grounding Electrodes

2581. WATER PIPE. A metallic underground water piping system, either local or supplying a community, shall always be used as the grounding electrode where such a piping system is available. If the buried portion of the metallic piping system is less than ten feet (including well casings bonded to the piping system) or there is some likelihood of the piping system being disconnected, it shall be supplemented by one or more of the grounding electrodes recognized in sections 2582 and 2583.

2582. OTHER AVAILABLE ELECTRODES. Where a water system as described in section 2581 is not available, the grounding connection may be made to any of the following:

a. The metal frame of the building, if effectively grounded;

b. A continuous metallic underground gas piping system;

c. Other local metallic underground systems, such as piping, tanks, and the like.

2583. MADE ELECTRODES. Where electrodes described in sections 2581 and 2582 are not

available, the grounding electrode shall consist of a driven pipe, driven rod, buried plate or other device approved for the purpose and conforming to the following requirements:

a. PLATE ELECTRODES. Each plate electrode shall present not less than 2 square feet of surface to exterior soil. Electrodes of iron, or steel plates shall be at least ¼ inch in thickness. Electrodes of non-ferrous metal shall be at least 0.06 inch in thickness.

b. PIPE ELECTRODES. Electrodes of pipe or conduit shall be not smaller than of the ¾-inch trade size and, if of iron or steel, shall have the outer surface galvanized or otherwise metal-coated for corrosion protection.

c. ROD ELECTRODES. Electrodes of rods of steel or iron shall be at least ⅝ inch in diameter. Approved rods of non-ferrous materials or their approved equivalent used for electrodes shall be not less than ½ inch in diameter.

d. INSTALLATION. Electrodes should, as far as practicable, be imbedded below permanent moisture level. Except where rock bottom is encountered, pipes or rods shall be driven to a depth of at least 8 feet regardless of size or number of electrodes used. Pipes or rods when less than standard commercial length shall preferably be of one piece. Such pipes or rods shall have clean metal surfaces and shall not be covered with paint, enamel or other poorly conducting materials. Where rock bottom is encountered at a depth of less than 4 feet, electrodes shall be buried in a horizontal trench, and if pipes or rods are used as the electrode they shall comply with paragraphs b and c of this section and shall not be less than 8 feet in length. Each electrode shall be separated at least 6 feet from any other electrode, including those used for signal circuits, radio, lightning rods, or any other purpose.

Two other pertinent references to the NEC are Sections 2584 and 2586:

2584. RESISTANCE. Made electrodes shall, if practicable, have a resistance to ground not to exceed 25 ohms. If the resistance is not as low as 25 ohms, two or more electrodes connected in parallel shall be used.

> Continuous metallic underground water or gas piping systems in general have a resistance to ground of less than 3 ohms. Metal frames of buildings and local metallic underground piping systems, metal well casings, and the like, have, in general, a resistance substantially below 25 ohms. It is recommended that in locations where it is necessary to use made electrodes for grounding interior wiring systems, additional grounds, such as connections to a system ground conductor be placed on the distribution circuit. It is also recommended that single electrode grounds when installed, and periodically afterwards, be tested for resistance.

2586. USE OF LIGHTNING RODS. Lightning rod conductors and driven pipes, rods or other made electrodes used for grounding lightning rods, shall not be used in lieu of the made grounding electrodes required by this Article for grounding wiring systems and equipment. The foregoing provision shall not be taken to forbid the bonding together of the several made electrodes that are respectively provided for electric wiring systems and equipment for communications systems, and for lightning protection.

Figure 1. Ground conductor connected to water pipe as recommended in NEC, Section 2581.

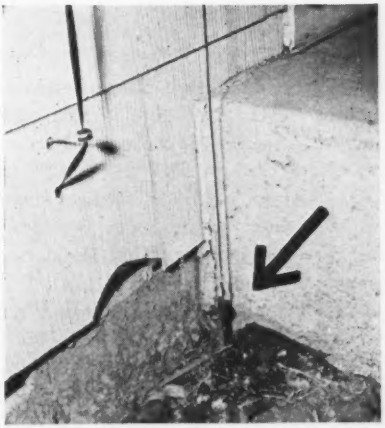


Figure 2. Ground conductor connected to a "made" electrode as recommended in NEC Section 2583.

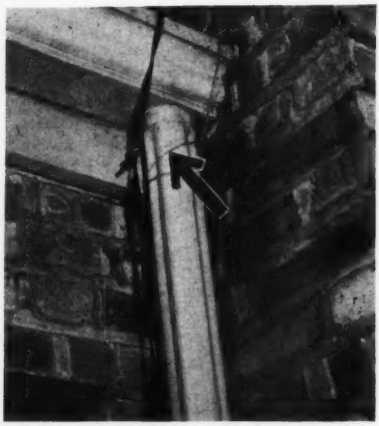


Figure 3. *Improper* method of running and connecting a grounding conductor. It should *not* follow the contours of building and should *not* be connected to down spout (see wire wrapped around spout at arrow.)

The foregoing sections of the National Electrical Code specify various suitable electrodes. Two common methods of terminating a grounding conductor at an electrode are shown in Figures 1 and 2. In Figure 1, the grounding conductor is terminated in compliance with Section 2581; while Figure 2 complies with Section 2583.

It should be noted, however, that the last sentence in Section 2586 allows the bonding together of several electrodes that are provided for various protective measures. This includes the grounding electrodes for the interior wiring system, communication systems and lightning protection equipment. Many authorities strongly recommend this procedure. The Underwriters' Laboratories standard requires that *all* protective grounds be interconnected (bonded) to the lightning protection systems. The object is to prevent a side flash between separate grounding systems. It then follows that the rod electrode shown in Figure 2 should be bonded

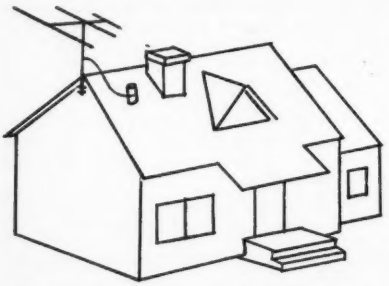


Figure 4. *Improper* method of grounding to sanitary stack-vent pipe. This type installation may result in serious life and fire hazards.

to the metallic water pipe system. It is appropriate to call to the readers 'attention that grounding clamps should be of an approved type such as in the case with the grounding clamp pictured in Figure 1.

Common improper installations are shown in Figues 3 and 4. The grounding conductor in Figure 3 does not comply with Section 8155, nor are the conductors in either of Figures 3 and 4 connected to a suitable grounding electrode. Unfortunately, many thousands of television antennas have been installed using improper grounding electrodes. The use of sanitary stack-vents and conductor spouts, as grounding electrodes, may result in serious life and fire hazards.

In some installations, the dissipation of static charges by means of unsuitable grounds, which do not comply with Section 2584, because of high resistance, may result in stray currents that can cause unpredictable damage. (See Figures 14 and 15.)

Antenna Receiving Stations

Section 8121b of the NEC reads:

b. SELF-SUPPORTING ANTENNAS. Outdoor antennas, such as vertical rods or dipole structures, shall be of non-corrodible materials and of strength suitable to withstand ice and wind loading conditions.

Discussing the foregoing quoted section, two of the major problems that arise on television installations are:

1. The proper method of supporting high arrays* often used in rural areas.

High masts are installed due to distance relationship between the transmitting station and the location of the receiving antenna. A direct line-of-sight must be maintained between the transmitting antennas and the receiving antennas. The inherent danger of high masts in close proximity to elevated electrical distribution lines is discussed under the heading "Power Lines."

2. Because of the ease of installation, many antennas have and are being supported directly on parapet walls and chimneys.

Observers throughout the United States have reported considerable damage to these portions of buildings during severe wind storms. Heavy stress often occurs on antenna supports due to the wind and ice-loading to which the television antenna is subjected. In some cases the damage to chimneys of several types was below the roof line. Figure 5 is an example of an antenna which may, in the future, cause damage to the chimney creating a serious life or fire hazard.

Figures 6, 7 and 8 are good examples of recommended methods of mounting television antennas. With this method of mounting, possible roof damage is slight.

It has been reported that in several counties of one mid-western state, fire insurance companies will not cover property wherein a television mast is supported directly on any type of chimney.

*The term "array" refers to the combination of radiating elements on TV masts phased to give greater gain and directivity to the antenna.

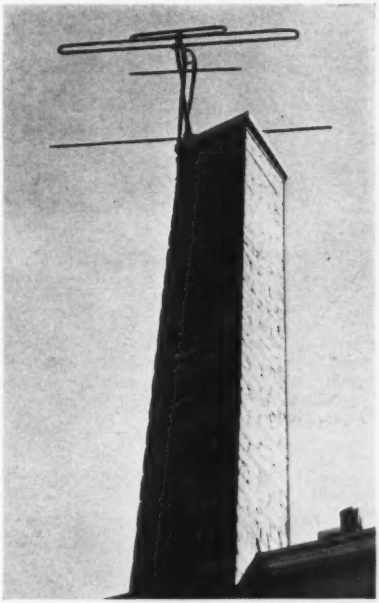


Figure 5. The chimney illustrated is vulnerable to damage with the extra wind-load imposed by the TV antenna.

Lightning Arresters

The National Electrical Code states:

8141. LIGHTNING ARRESTERS — RECEIVING STATIONS. Each conductor of a lead-in from an outdoor antenna shall be provided with a lightning arrester approved for the purpose, except that if the lead-in conductors are enclosed in a continuous metallic shield the lightning arrester may be installed to protect the shield or may be omitted if the shield is permanently and effectively grounded. Lightning arresters shall be located outside the building, or inside the building between the point of entrance of the lead-in and the radio set or transformers, and as near as practicable to the entrance of the conductors to the building. The lightning arrester shall not be located near combustible material nor in a hazardous location.

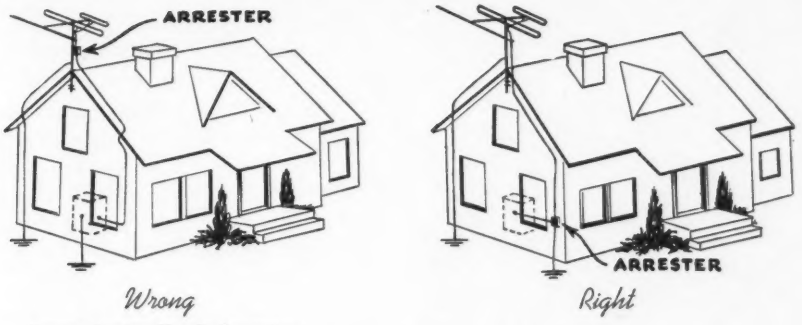
Many questions have been raised regarding the position of lightning arresters on television and FM antenna systems, particularly the advisability of mounting the lightning arrester on the antenna mast itself, thereby making use of the ground lead which protects the antenna mast.

Courtesy American Phenolic Corporation

Figure 6

Illustrations of correct methods of mounting antennas. Note that these methods eliminate possible damage to roofs.

Figure 8



Courtesy American Phenolic Corporation

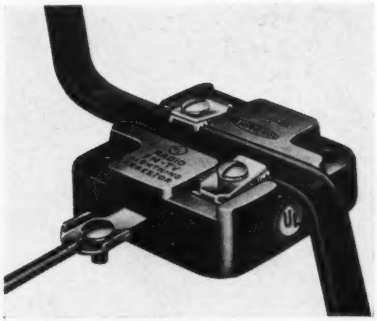
Figure 9. The right and wrong way of installing a lightning arrester. Installation on the antenna mast leaves the receiver virtually unprotected. If, however, the arrester is mounted approximately as near to earth as the receiver, lightning induced charges may be carried to ground efficiently.

Mounting of the lightning arrester on the antenna mast is not advisable and in fact it is believed that such an installation leaves the receiver entirely without protection. Most transmission lines on television antennas are connected to the antenna mast if the receiving element is a folded dipole, and therefore an additional point of connection between the transmission line and mast within a few feet of the direct connection serves no useful purpose.

Instances of a direct lightning strike on the television antenna are extremely infrequent. When charges accumulate due to lightning, it is the purpose of the lightning arrester to provide maximum protection to the receiver and a safe discharge of the inductive charges to ground in a manner which would prevent damage. Maximum protection is made available when the lightning arrester is located at a point on the transmission line (lead-in conductors) which is physically near the earth or at least as near the earth as the receiver. If the antenna mast has a direct connection to ground, as required by the National Electrical Code, a major portion of the discharge will be carried to ground via that circuit. Some energy will be passed down the transmission line and if the lightning arrester is situated properly, a major portion of the transmission line discharge will go to ground through the lightning arrester.

A fact seldom considered in respect to lightning protection of TV, FM and conventional receivers is that ordinarily one side of the 110-volt supply circuit is grounded and any lightning discharge will have an alternative path to ground through the receiver itself. If the lightning arrester is mounted on the antenna mast, lightning discharges can pass to ground through the mast ground circuit or directly through the receiver. Due to the complexity of a television receiver, the possibilities of heavy damage are considerable, and therefore, it is extremely important on television installations that the lightning arrester be located at or near the entrance of the transmission line to the building in which the receiver is located.

Through the use of suitable lightning arresters, the antenna system is constantly grounded through a high resistance network which has no effect on signal recep-



Courtesy American Phenolic Corporation

Figure 10. An Underwriters' Laboratories labelled lightning arrester suitable for inside or outside installation.

tion, and therefore minor static discharges are carried to ground before the voltage can build up to a level which will cause interference in the receiver. A heavy discharge is passed directly across the gaps to ground.

The right and wrong method of installing lightning arrester protection is shown in Figure 9. Figure 10 pictures an approved lightning arrester suitable for installation either inside or outside of a building, wherever attachment to the lead-in conductors and the ground conductor is most convenient. In Figure 11, there is pictured an approved lightning arrester which is connected to and supported by the water pipe by means of a metallic band.

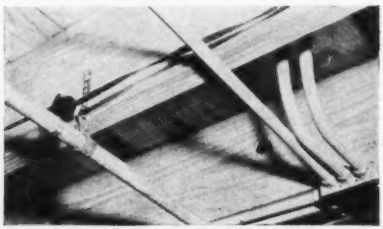


Figure 11. An approved lightning arrester connected to and supported by the water pipe by means of a metallic band. This is just inside the exterior wall of the house.

A lightning arrester of the type intended for television or FM antennas should be installed at the point where the ribbon lead-in wire enters the building. The coaxial type of a lead-in wire does not require an arrester if the sheath conductor is grounded. The ground wire from the arrester should also be connected to approved ground electrodes as in the case of the grounding wire for the mast.

Arresters of both indoor and outdoor types are listed by Underwriters' Laboratories, but, regardless of type, the arrester should be installed where the lead-in enters the building.

Indoor antennas do not require grounding or arrester protection, but both antenna and lead-in wires as well as lead-in wires from outdoor installations should be spaced at least two inches from other wiring except where the other wiring is in metal armor or pipe. Porcelain tubes or other suitable protection should be provided where spacings are not feasible.

Power Lines

Figure 12 is a photograph of a high antenna array supported on a structural tower in close proximity to power lines. It is apparent that without substantial support, this antenna and tower could possibly fall across utility distribution wires. Figure 13 is a view of an antenna supported by a pole not properly guyed which fell across utility wires. Note the fire damage to the side of the house. This damage is further shown in Figure 14. The wires entering the building are (left to right): (1) the antenna lead-in conductor and (2) control cable for the rotating mechanism located on the top of the pole at the base of the array.

Figure 15 illustrates damage which may occur as a result of stray currents. It is

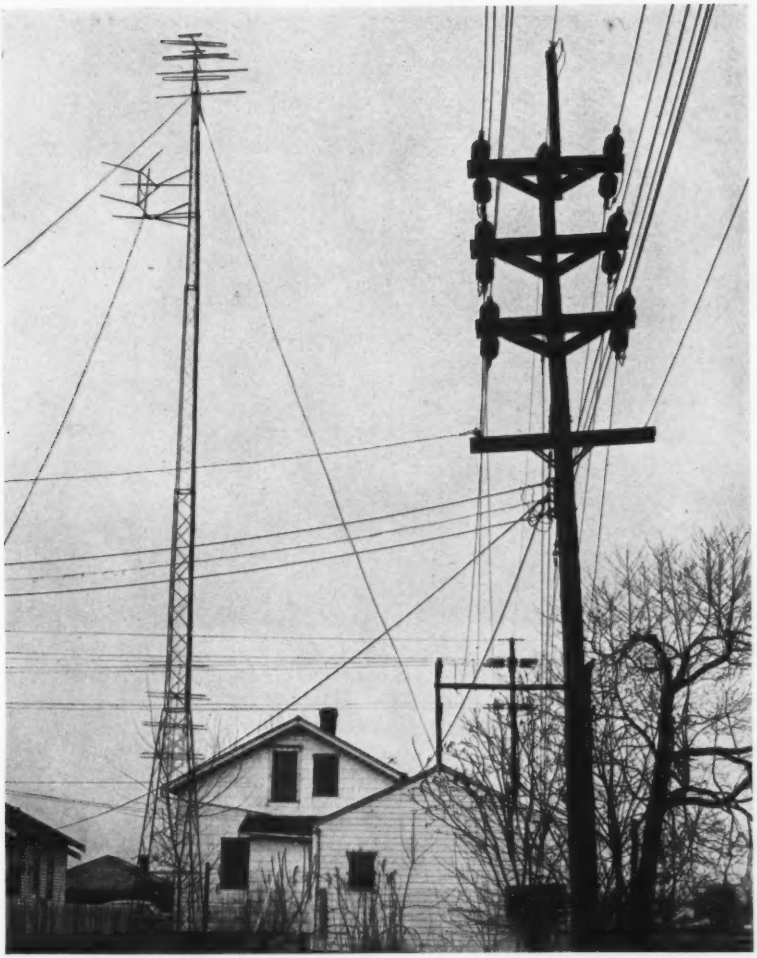


Figure 12. A high, poorly supported tower such as this one in close proximity to power lines might cause serious trouble if it should fall against the power lines which virtually surround the tower.

assumed from this photograph that the current was attempting to reach ground through a path from the sanitary stack vent-pipes to the water pipes. Unfortunately, when this accident occurred, the lady of the house was seriously burned on the face and arms, as she was standing in front of the sink.

Clearance for Fire Fighters

Television antenna installers must constantly be aware that antenna wires and large dipole structures may seriously interfere with firemen when raising ladders or handling hose lines. This may be important in closely built areas where atten-

Figure 13. This antenna fell on utility wires. Note the fire blackened spot on the house. (Figure 14 shows greater detail.) Inadequate guying of the mast, despite its height, was responsible. (See also Figure 15.)

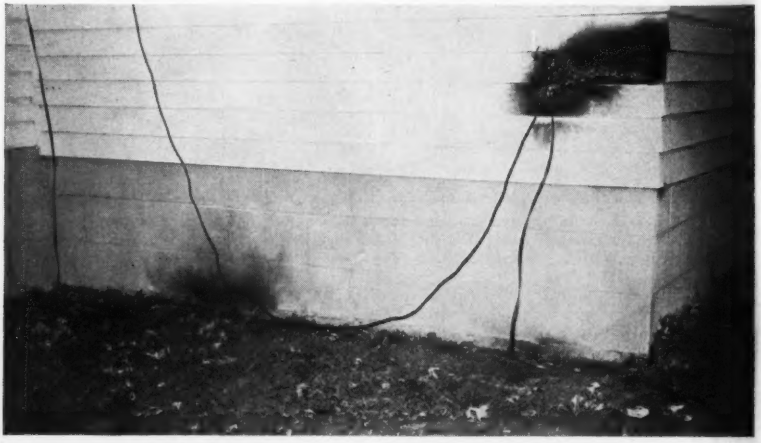


Figure 14. Close-up of damage shown in Figure 13 indicates degree of charring. Wire to left is the antenna lead-in conductor and wire to right is the control cable for the rotating mechanism located on the pole at the base of the array.

Figure 15. When the stray currents entered the dwelling photographed in Figures 13 and 14, the current apparently reached ground via the sewer pipes to the water pipes. The householder was seriously burned on the face and arms as she was standing in front of this sink when the current struck.

nas and wires may overhang or bridge space between buildings. Perhaps more serious is that high antennas on roofs or improperly supported towers may, under fire exposure, be so weakened that they might collapse and injure fire fighters or occupants.

Rotary Antennas

Where transmitting stations are located at widely separated compass points in relation to the receiving station, it is considered more desirable to install rotating mechanisms. Such rotators should be of an approved type and the control cable should be protected with a lightning arrester. When mounting these rotating units, additional support is often required.

Rotatable antenna attachments using low voltage motors have been designed to meet National Electrical Code requirements. Attachments listed by Underwriters' Laboratories are provided with detailed installation instructions that cover additional lightning protection details.

Master Antennas

Many apartment house owners prohibit the installation of television antennas on apartment buildings. One answer to this problem is the use of a master system, the units of which are pictured herein. Figure 16 shows four arrays used on four channels and frequencies in operation simultaneously. Each array is equipped with its own lead-in conductors which appear in the left of Figure 17.

Figure 17 also shows a signal amplifier which is mounted in close proximity to the antenna entry. The signals are then carried through the larger co-axial cable from the amplifier to the various tenants.

Figure 18 displays a "tee tap" used to supply the lead-in conductors from the main cable.

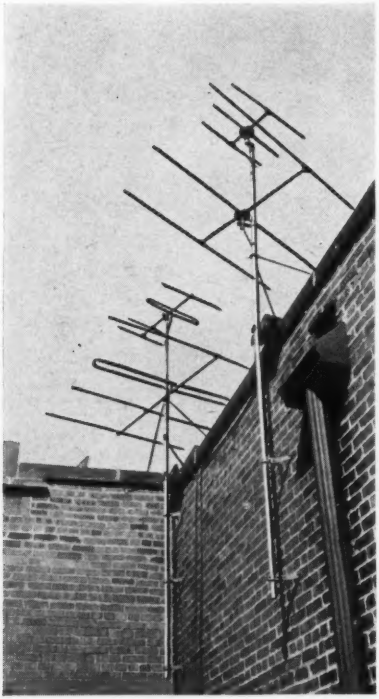


Figure 16. "Master" antennas are used for multiple occupancy apartment buildings. This shows four arrays for use on four channels and frequencies simultaneously. Each is equipped with its own lead-in conductors. (See Figures 17 and 18.)

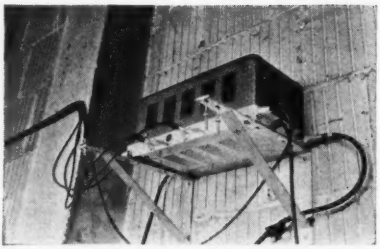
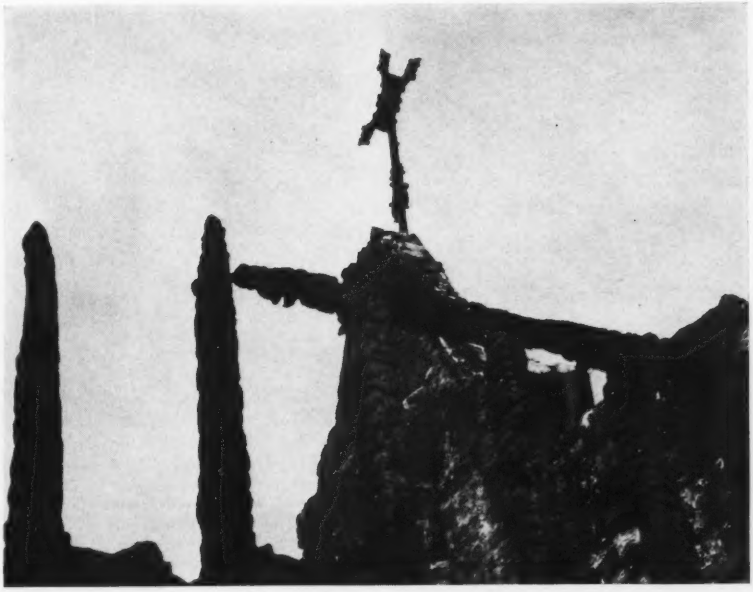


Figure 17. Signal amplifiers are used on master antennas and mounted close to the antenna entry. Wires to left are four lead-in conductors; large wire to right shows co-axial cable which runs to various receivers.

Figure 18. A "tee tap" used to supply the lead-in conductors from the main cable.

Summary

Well-engineered and properly installed television antennas which comply with the rules as set down in the National Electrical Code (NFPA No. 70, and the Code for Protection Against Lightning, NFPA No. 78) should result in applications that are reasonably safe, reduce losses and provide greater protection to the public.



Bier

Montreal Hospice Fire

By James K. McElroy
Assistant Technical Secretary, NFPA

Fire originating in the second story corridor of the 65-year-old unsprinklered Hospice St. Cunegonde in Montreal, Quebec, just before noon June 15, 1951, cost the lives of Mother Superior Rita Gervais, Sister Chauvin, 28 aged women, and 5 women employees. At the time of the fire 341 occupants are known to have been in the building: 108 aged men and women (some blind or crippled), 182 children between the ages of 5 and 13 years, 26 nuns, and 25 employees of the Grey Nuns Order who operated the Hospice.

It is an ironic twist of fate that the 35 victims of the holocaust at the Hospice St. Cunegonde were accorded a civic funeral service attended by thousands at the famous Parish of Notre Dame Church, a hallowed edifice protected by automatic sprinklers.

Monthly fire drills, suggested by the Montreal Fire Department, were responsible for the safe evacuation of all the children (most of them at lunch) without panic. Many of them were on upper floors and had to pass through smoke filled corridors. The aged women who lost their lives were trapped in their rooms in the third, fourth, and fifth stories. Mother Superior Gervais was last seen disappearing into the smoke carrying a fire extinguisher. The aged men residents lived in

the lower stories of the building and were evacuated without difficulty. Fifty women and ten men were saved by firemen over ladders. Many were saved by the Hospice staff down narrow precipitious fire escape stairs from wood galleries (porches), and by contractor's employees, near-by residents, and others who led occupants to safety down an inside open stairway in the center of the building.

Discovery and Alarm

Just before noon an aged man stepped from the second story chapel into the corridor. He saw smoke issuing from a non-flameproofed tarpaulin that enclosed an opening to an elevator shaft under construction. He informed the Chaplain who immediately sounded the building alarm bell near the central stairway on the first floor, and returned to the scene to be driven back by fire rapidly spreading toward an open wood stairway 50 feet away at the end of the corridor.

Bier

At least 60 lives saved by firemen over ladders in the fire at the Hospice St. Cunegonde. Six aerial ladders used as water towers when rescue operations completed.

Bier

The westerly section of the Hospice St. Cunegonde early in the fire at noon June 15, 1951. Loss of life occurred in the third, fourth, and fifth stories in the area obscured by smoke.

A telephoned alarm from the Hospice was received by the Montreal Fire Department at 11:49 A.M. and a street box alarm from the corner outside the building was received simultaneously. The department responded promptly from a station 3 blocks distant. The second alarm was transmitted at 11:53 A.M. and the third alarm at 12:00 noon brought more than 200 men and their equipment to the scene.

The Building

Despite the prompt fire department response, the westerly section of the building was well involved upon arrival. It is an unsprinklered building built in 1886 of a type common in the Montreal area, with stone exterior bearing walls, brick interior corridor walls, heavy wood-joist floors (some cinder filled in the corridors). It is five stories (80 ft.) high, full basement

(more than half its height above grade), and low attic, of approximately 15,000 square feet of floor area per story. There were three open wood stairways. Wood lath and plaster interior finish predominated. A type of thin pressed paper wall board nailed directly to wood lath had been utilized to refinish the interior of rooms and corridors where plaster had had to be removed. Wood doors and plain glass transoms were installed throughout the building.

Firemen overhauling the building found electrical wiring concealed between the subfloor and surface flooring in the corridors without protection against mechanical injury. The boiler, the laundry and a repair shop in the basement, and the kitchen on the fifth floor were not involved.

La Presse

Interior of the westerly section of the Hospice St. Cunegonde. In this area the third, fourth, and fifth floors collapsed into the second story. The ruins of the chapel (located across the corridor from the new elevator shaft) in the background.

Bier

The corridor of the first story of the Hospice St. Cunegonde following the fire. Note the temporary tarpaulin enclosure for the elevator shaft under construction at the left, and brick corridor bearing walls.

Cause and Fire Spread

Funds for a new elevator had recently been provided by the Provincial Government Department of Public Assistance to replace worn out hand operated equipment of the "dumb-waiter" type. New masonry enclosure walls were nearly completed, and workmen were engaged in the clearance of interfering steel I-beams at each floor level within the shaft with oxy-acetylene cutting equipment.

The I-beams below the fifth floor level had been removed without incident, al-

though no special precautions* were taken to prevent the ignition of the temporary wood scaffolding within the shaft or the temporary tarpaulin enclosure just outside it in each corridor. Standpipe and hose and 2½-gallon extinguishers were accessible at each story within 10 feet of the shaft opening. Had the fire department been informed that this hazardous operation was to be conducted, adequate personnel familiar with the hazards could have been provided. In the absence of precautionary measures, sparks from the cutting torch ignited the tarpaulin in the second story corridor.

The fire rapidly spread laterally in the corridor to cut off the open stairway at the west end of the second story and vertically up the stairway to the upper stories and the roof. It is believed that the space immediately above the new elevator shaft was open into the attic and that rapid spread of fire in the roof structure can be attributed to the passage of heat into the attic through the opening into the shaft at the fifth floor level. The temporary scaffolding in the shaft was only slightly charred at the second floor level and otherwise undamaged below the fifth floor level.

Fire Fighting

For many years the Montreal Fire Department has inspected this and other public and private institutions in their jurisdiction. The department was thus cognizant of the rescue operations which might be a dire necessity on their arrival. Director Raymond Paré dispatched the Department's new 100 ft. Magirus aerial ladder, 3 ladder companies, and three pumper companies beyond the normal third alarm response by radio as he was leaving fire department headquarters.

In all 44 hose streams, 38 combined into deluge nozzles and 6 single streams, were used to bring the fire under control in approximately 2½ hours. Eleven pumpers, 7 aerial ladders (6 used as water towers), 6 city service ladder trucks, 8 hose wagons, 4 salvage companies, and 1 rescue company were utilized. The Director and 9 other major staff officers responded.

In their successful effort to prevent the loss of the entire building, the largest quantity of water ever delivered on a fire of this nature in Montreal was used. Twenty-three thousand feet of 2½-inch hose, 1,050 feet of 1½-inch hose, 147 salvage covers, and 1,424 feet of ladder equipment were employed.

It was fortunate that the main area of fire in the westerly portion of the building was accessible from all sides of the building. Ladders could be placed in two streets and on the railroad tracks in the rear of the building. The fourth story corridor could be reached from the roof of a three-story building adjoining on the east. The fire was very ably controlled in the upper stories near the central open stairway, with little but water damage in the first story and basement.

Director Paré was unquestionably correct in his statement following the fire. "Had the fire occurred at night and under winter weather conditions, all, or nearly all, of the occupants might have lost their lives." The heavy corridor walls, and numerous partitions for dormitories, schoolrooms and private rooms, interfered with the application of hose streams. With unsafe exits and probable delay in alerting occupants under night time conditions, it

*See NFPA and International Acetylene Association booklets (NFPA No. 51A) describing safeguards for the prevention of welding and cutting fires.

Bier

The rear of the Hospice, showing wood galleries (porches) and steep fire escape stairs (in galleries at right). Major damage was confined to the area to the right of the hose streams. Brick corridor walls and numerous partitions interfered with distribution of water. 44 streams, 38 used in combination with deluge nozzles, were used on all sides of the building.

would have been a miracle had any of the old people and most of the children escaped to safety.

Recommendations

This fire is an excellent example of the frustration often felt by those engaged in fire prevention and protection activities. The building had been inspected at intervals since 1927. James McIsaac, Chief Inspector of the Montreal Fire Department, sadly showed the writer inspection reports written in 1940 and repeated at regular intervals since. They contained recommendations sent to Hospice authorities which would have avoided the loss of life had they had favorable action.

The Department did not, and still does not, have the legal authority to force compliance with its recommendations. Included in the 1940 lists were such major preventive measures as the enclosure of the open stairwells, the installation of automatic sprinklers, a complete automatic fire alarm system, additional exits, posting of exit signs, etc.

The Hospice St. Cunegonde is but one of many similar institutions without adequate protection for those sheltered there-

in. All such institutions in Montreal have been inspected by the Fire Department. Specific recommendations which have been issued to all institutions should now have the most serious attention of the highest authorities responsible.

In 1938, the Fire Prevention Bureau mailed a letter to all institutional authorities in Montreal calling attention to hazards similar to those prevailing in the Hospice St. Cunegonde.

In a further effort to arouse interest, the Fire Department in 1945 published an 8-page pamphlet, "Nos Maisons d'Enseignement, Hospices, Orphelinats, Pensionnats, VOULOIR c'est POUVOIR les sauver de l'incendie," calling attention to the hazards of delay in sending an alarm to the department, inadequate exits, lack of automatic sprinklers, etc. This pamphlet was widely distributed to administrative authorities of hospitals, schools, homes for the aged, and children's homes. Following are a few quotations translated from the pamphlet—still applicable in many Montreal institutions as well as others throughout the world:

"We are too much inclined to consider fire catastrophes (as at the Hospice St. Cunegonde, ED. NOTE) inevitable, as if such a fate were wished upon us by a supernatural power. This is a serious error. To those who are well acquainted with the problem, such resignation is seen to be an excuse, or a curtain behind which one may hide negligence."

Woods

More than 100 aged men and women, and more than 175 boys and girls were boarders in congested dormitory space in all stories of the five-story and basement Hospice St. Cunegonde. It is considered fortunate that the fire occurred in daylight hours when fire drills, practiced by the children, were effective in their evacuation without loss of life.

NFPA

Approximately one-third of the Hospice was destroyed in the holocaust of June 15. The fire originated in the second story corridor, spread to an open stairway (the staggered windows in left center) and then to the upper stories and roof.

"In cases where there is rapid spread of fire and large loss of life even if the alarm is given promptly, one or more safety measures have been neglected. Stairways, elevator shafts, ventilation shafts, linen chutes, etc., have not been closed in a manner which will retard or stop the flames. Money spent to enclose these openings is capital well spent. . . ."

" . . . if the expression, 'A human life cannot be valued in money' is valid and one is not scornful of its eventual value, one does everything to save life."

"If the problem involves the protection of large numbers of small children, some of whom can hardly walk, or bed-ridden invalids, or old people it must be realized that it will take a long time to get them out of the building even if there are enough people to do it.

"Such persons should be placed on lower floors, or if that is too much effort, or special conditions bar it, an automatic sprinkler system is the only sure way to protect them.

"Here we run into the same objections: too expensive, insufficient rate reduction, etc. One can only answer that it is not a question of money but of lives."

If loss of life can occur under the conditions known to exist in the Hospice St. Cunegonde, protected by a powerful municipal fire department, even larger losses of life and property may be expected under similar inferior building conditions which lack adequate public as well as private fire protection facilities.

It is easy to agree with the radio news announcer, broadcasting from Montreal on the evening of June 15 , "Thank God the fire did not occur at night!"

Professional Fire Protection Engineers*

By Dr. Henry T. Heald

President, Illinois Institute of Technology

I am extremely glad to participate at this First Annual Meeting of the Society of Fire Protection Engineers. It is a field in which I have been interested for a long time, not that I have been a practitioner in this field, but because I have a great many friends in it and, of course, the Illinois Institute of Technology has a great many alumni who actively engage in the practice of fire protection engineering. I think your organizing committee, your officers and the National Fire Protection Association should be congratulated on reaching this stage in the development of the Society. This Society is founded, as I understand it, on the assumption that fire protection engineering is a professional activity, and if that is true, maybe it would be worth while for us to examine these things which make an activity "professional" and which differentiate it from all of the other kinds of useful occupations which exist in our general society.

Difficult to Define a Profession

Actually, it is a rather difficult task to define a profession. Certainly, it takes a good deal more than a fancy name. In spite of the fact that there is a very natural and, in many respects, commendable tendency to dignify a great many occupations by making them "professions," many of these occupations have not and probably will not reach professional status. We see this tendency in many businesses. We used to hear about the undertakers. Now, they have become morticians, they practice mortuary science. Not infrequently even the barbers adopt fancy names. Even our own term "engineer" is being appropriated by people who think that by becoming exterminating "engineers" or some other kind of engineers they can, by the use of a name, give a special glamour and a special professional character to the occupation which they perform.

Of course, that really does not do it, and neither, as a matter of fact, does a license certificate create a profession. A great many occupations are licensed which are not professional. It is not possible to practice as a plumber in certain localities without having the proper license credentials. Yet we generally do not think of plumbing as being a truly professional

Editor's Note: Speaking at the First Annual Meeting of the Society of Fire Protection Engineers, Dr. Heald outlines in this paper some of the attributes of a profession as they may apply to fire protection engineers. Dr. Heald's position as President of the Illinois Institute of Technology and as past President of the American Society for Engineering Education makes his remarks on this subject of particular significance to those engaged in this work and particularly to those seeking membership in the SFPE.

*Based on a talk presented at the First Annual Meeting of the Society of Fire Protection Engineers held at the 55th Annual Meeting of the National Fire Protection Association, May 7-11, 1951 (Program item No. 48).

activity. Neither does the creation of a so-called professional society make an occupation a profession, although it is frequently one of the characteristics of a profession.

There are a good many different types of professions and professional activities. We have what we might classify as the "closed" professions, like medicine and law. These professions are "closed" in the sense that you and I cannot practice medicine or law without meeting certain legal requirements which are pretty clearly stated and fairly rigidly enforced. We also have what we might call the "open" professions, like music or art; professional activity which anyone may engage in if he can display a sufficient degree of ability. Engineering, generally speaking, falls in the intermediate ground. It is not, strictly speaking, an "open" profession, and certainly it is not, strictly speaking, a "closed" profession.

Characteristics of a Profession

What are those characteristics which we are inclined to associate with a profession?

First, and most important perhaps, is that a profession must represent a body of knowledge which requires special training to obtain and the use of which knowledge results in an activity on a high intellectual plane. In other words, it has a special body of knowledge which is acquired by some kind of training, whether it be formal academic training or training on the job, and the use of that knowledge is an intellectual activity.

Second, it seems to me that one of the characteristics of a profession must be that there is a strong motive of service over profit. In other words, the motive of service is more important than the motive of profit to the individuals who practice that profession. There must be a high sense of individual responsibility on the part of the people who engage in the activity. The individual and the members of his group must recognize that they have assumed a social responsibility by the obligation which is imposed on them by belonging to the profession.

Third, there must be for any profession some standards of qualification for the individual in both competency and character. In other words, standards for the technical ability of the people engaged in the profession, standards for their personal conduct in the execution of their profession, standards of conduct in relation to the public, standards in relation to their clients and in relation to their colleagues.

Fourth, there must be recognition on the part of the members of the profession that they have some responsibility to education. They should take an interest in and some cognizance of the standards maintained in the technical education provided and they should attempt to develop procedures for assisting beginners who are planning to go into the work. Collectively, the members of a profession are, to a certain extent, the trustees of the knowledge which is the common background of the profession, and it is their responsibility not only to share that knowledge with people already practicing but to see that that knowledge is shared with young people who aspire to enter the field.

Fifth, there must be a more or less formal recognition of "status" in a profession by one's colleagues and, perhaps, recognition by the state through a licensing procedure. The latter aspect is not an essential characteristic of a professional

activity but is one which is commonly encountered.

Sixth, a profession has an obligation to guarantee to the public the competence of its members. In the final analysis, the public will judge the competence of a profession. The recognition which a profession gets will be measured by the effect which the profession has on the public. Of course, in individual cases, the public is not in a position to judge the competence of individuals practicing a profession because the public does not have the special knowledge required to determine whether one member or another is qualified. If it should happen that I had to have an operation for appendicitis in a strange city, I would have no way, myself, to determine who was qualified to perform such an operation. I would have to depend upon the professional mark of approval which had been placed on the medical practitioner by his profession and, of course, by the state, in the case of medicine. This is as a protection to the public. It is a general characteristic of a profession.

How Engineering Fits Into the Picture

Those rather general statements represent what I think are the primary general characteristics of any professional activity. In engineering, we have represented one of the professions. There are people, however, who say that certain phases of engineering are not truly professional and that when we talk about the "engineering professions" we are talking about something which it is almost impossible to define.

In certain respects, this is true. There are certain types of engineering activity which are highly professional in character but there are other types which, while equally useful to the general public and to the people who practice them, do not, strictly speaking, meet all the professional qualifications that we have been talking about. We are primarily concerned with the identification of those kinds of engineering activity which are professional in character.

Not all engineering graduates, people with an engineering education, participate in professional engineering. Not all people associated with engineering are professional engineers. Some of them might come under the general classification of what has sometimes been called the "engineering fraternity" rather than the "engineering profession." Engineering itself, for that very reason, suffers a little bit in the mind of the public because of the wide variety of things which engineers do and the difficulties that we have, even as engineers, in defining with precision just exactly what an engineer is and what an engineer does.

All of you have read a great many definitions of engineering and you probably remember when you studied engineering, the broad definition that "an engineer is a man who applies the forces and materials of nature for the benefit of mankind," and some other statements similar to that which are frequently used. I think it is necessary to be more precise.

The Engineers' Council for Professional Development* about a year ago drafted a definition of an engineer which seems to me to describe more nearly the work of an engineer than any other statement that I have seen or been able to develop. The statement says:

*29-33 West 39th St., New York 18, N. Y.

"An engineer is characterized by his ability to apply creatively scientific principles to design or develop structures, machines, apparatus or manufacturing processes or works utilizing them, singly or in combination, or to construct or operate the same with full cognizance of their design and of the limitations of behavior imposed by such design, or to forecast their behavior under specific operating conditions, all as respects their intended function, economics of operation and safety to life and property."

I think if you examine that definition carefully, you will find that it includes all of the activities which engineers ordinarily perform, at least all of the activities which "professional" engineers ordinarily perform. It makes a distinction between the engineer and a good many other people who practice professional activities. It makes a distinction between the engineer and the physicist or the chemist, in other words, between the engineer and the scientist, and it is a fairly accurate definition of engineering.

The particular thing which I should like to have you note in this definition is that it puts emphasis on the matter of an ability to design or an ability to understand a design, which means, of course, that it identifies a certain characteristic which must be inherent in the training of an engineer.

This definition was developed, oddly enough, not for the purpose of trying to define engineering, but for the purpose of trying to define the essential elements of an engineering curriculum. The Engineers' Council for Professional Development is constantly being besieged by all kinds of courses of study from a great variety of colleges. Many of these courses had the aim of engineering but some were not engineering, although, of course, very good education. Thus an attempt was made to differentiate that which identifies engineering. We came to the conclusion that it was this ability to design, or at least a type of training which attempted to produce the ability to design. Any engineering curriculum must contain basic science courses, applied science courses (such as mechanics, thermodynamics, etc.), applied engineering courses (which are ordinarily the design courses themselves), and, in a modern engineering curriculum, courses in administrative and management practices and a substantial amount of general educational background. The last two items, the administrative and management courses and the general educational background, are necessary for the development of a professional person, but they do not differentiate engineers from business managers or chemists.

The Society of Fire Protection Engineers

In the Constitution of the Society of Fire Protection Engineers you have brought out the fact that your organization is to "promote the art and science of fire protection engineering and its allied fields, to maintain a high professional standing among its members and to foster fire protection engineering education."* These are fundamentals of a professional society. It is to be devoted to the advancement of the profession and to the social duty of the profession rather than the problem of the maintenance of an economic monopoly for the members of that society. Your function is to serve the public in the best way that you can as professional people. In doing that, your society will logically carry on certain types of activities. It will be interested in the

*See Constitution of the Society of Fire Protection Engineers, Article 3.

advancement of knowledge through research and the exchange of information. It will be interested in the dissemination of that knowledge through your publications. It will be interested in considering matters of public policy in which its members have a particular competence. It will be perfectly appropriate and proper for your Society to give consideration to the economic problems of the members, although that is not a primary objective.

Your Society must, if it is properly to fulfill its function, maintain such qualifications for membership as will help provide some assurance to the general public that your members have a degree of professional competence. It must insist on maintaining ethical standards of high conduct consistent with the obligations of the professions.

A great many engineering societies of the country have adopted a statement called "Canons of Ethics" which was developed by a committee of the Engineers' Council for Professional Development. This statement spells out in broad and also in specific terms a code of ethics for professional engineers. It is a type of ethical standard which any professional society might do well to adopt.

Finally, I was glad to note in your Constitution that one of the functions of your Society was to give some attention to education. That is a normal function of a professional society and it is perfectly proper that such should be included in it.

A good many people say that there are already too many engineering societies. If you were to count the number of engineering societies, national and local, you would indeed find that there is a very large number. In some cases the various societies duplicate the work of existing organizations, although, in many cases, for a perfectly legitimate special purpose.

It is true, I think, that the engineering profession, speaking broadly, has suffered some in terms of public recognition by the lack of unity within the profession. It has sometimes seemed to me that engineering would be much better recognized if we had one national engineering society which was in a position to speak for all engineers. We do not have that kind of an organization in the engineering profession today. We have some steps which have been taken toward cooperation between the engineering societies, such as the Engineers' Joint Council and the Engineers' Council for Professional Development, and a variety of others. We also have at least one society, the National Society of Professional Engineers, which would like to become the national engineering society to speak for all engineers. At present, however, it appears to most of us that we do have a place for specialized engineering societies having a particular interest in the various branches of the profession.

It seems to me that there is a place for the Society of Fire Protection Engineers. Those of us who are reasonably familiar with fire protection engineering are easily convinced that it represents a distinctive area of engineering practice. If that is true, a Society, such as this, certainly can make an important contribution to the development of the field.

Fire protection engineering in a great many ways meets the general qualifications of a professional activity. The practice of fire protection engineering is certainly an activity in which those who really carry on important work in the field must put the public good ahead of their individual wel-

fare. It is a profession which, even more than other branches of engineering, is directly and immediately associated with the safety of the people and the safety of their property. I would conclude that it is proper and appropriate, and in fact, desirable for fire protection engineers to have this Society to work for the common advancement of the profession and for the welfare of the general public through the practice of that profession.

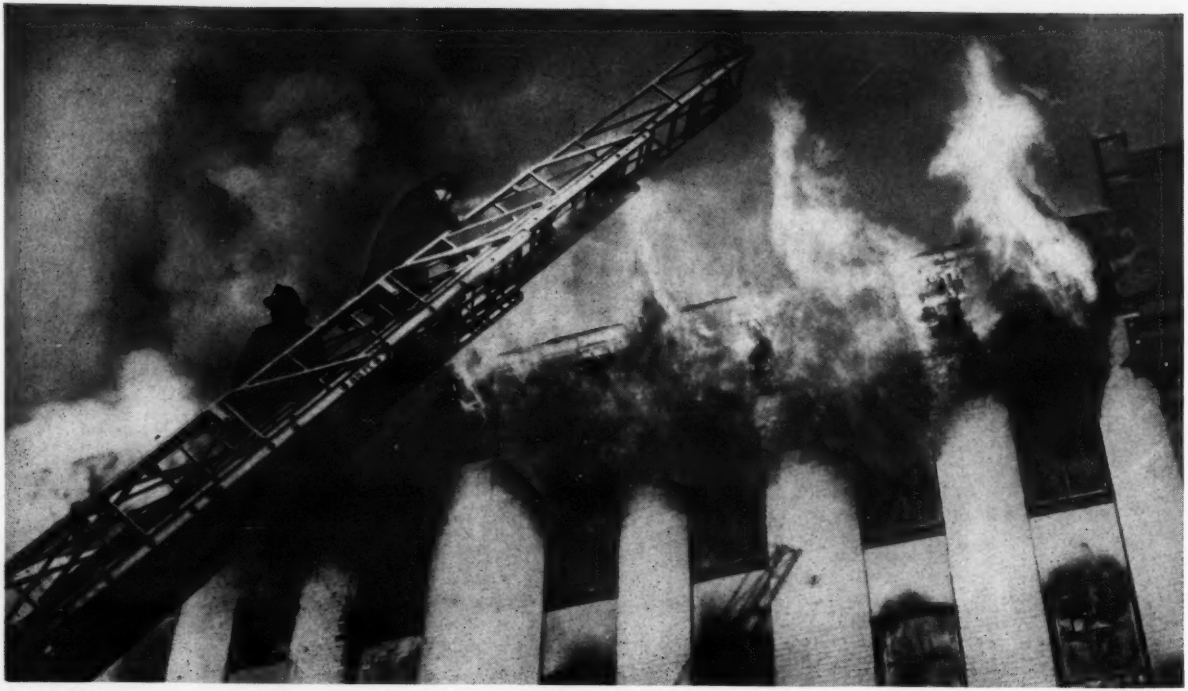
In conclusion, let me make one other point. No matter how great may be our technical skill in the practice of our profession, no matter how much research we may do of a technical character, technical skill in itself is not enough for professional people.

In a very attractive little book published by the Engineers' Council for Professional Development and written by the late William E. Wickenden, entitled, "The Second Mile," there is a statement of what I am trying to say. Mr. Wickenden points out that professional status is an implied contract to serve society over and beyond all specific duty to client or employer. In consideration of the privileges and protection which society extends to the profession, mere technical training on any level is really vocational instead of professional. No professional body can be strong and effective unless it contains a substantial nucleus of those people whose intellectual attainments far exceed in depth and in breadth the technical demands of its practice. I think your society of Fire Protection Engineers contains those people and certainly as it develops, there is no reason why it cannot contain more.

The Society of Fire Protection Engineers was organized in 1950 as a professional section of the National Fire Protection Association. Membership is based on specified professional qualifications as determined by the Executive Committee and the Qualifications Board.

Notices of organization meetings and membership of the Society have been published in Fire News and other NFPA publications; a record of the transactions of the first annual meeting of the Society appears in the NFPA Proceedings for 1951.

Further information about the Society may be obtained from the Secretary, Robert S. Moulton, 60 Batterymarch Street, Boston, Mass.



Wide World

Four firemen, three members of the Peterboro, Ontario Fire Department and one volunteer, died fighting this fire in a four-story mercantile building in downtown Peterboro on May 19, 1951. All four were trapped in the ruins of the multiple occupancy mercantile and apartment building when the two upper floors collapsed. In 1950 27 firemen were killed in line of duty according to a partial NFPA survey of 572 cities in the U. S.

Fire Casualty Statistics

By Halbert L. Dunn, M.D. and Evelyn H. Halpin, Ph.D.
National Office of Vital Statistics — Public Health Service — Federal Security Agency

EDITOR'S NOTE: *Absence of accurate and complete data on fire casualties has always been one of the principal obstacles in the way of those of us engaged in an educational program to improve life safety from fire. Realizing that lack of a generally accepted definition of a fire casualty was the primary reason that such data could not be produced, the NFPA Committee on Fire Casualty Statistics has been concerned since it was established in 1948 with the development of a "Definition of Fire Casualty" acceptable to all organizations and individuals concerned with the collection of accurate data on deaths and injuries from fire. As a member of this committee Dr. Dunn, one of the authors of this paper, has made several valuable suggestions during the development of the "Definition of Fire Casualty" tentatively adopted at the 1951 NFPA Annual Meeting. It is the urgent hope of the Committee that all fire officials will use this definition to compile their fire casualty statistics as only by so doing can comparable statistics be obtained.*

Fire is one of the important causes of disability and violent death. Fatalities from fire and its use number between 7,500 and 8,000 a year in the United States. Of this number about 5,000 deaths are due to *burns* suffered in fires, from clothes catching fire, contact with stoves, and burns from steam and hot water. The balance result from *conflagrations,* which include both burns and other injuries such as suffocation, crushing, or falls incurred in *burning buildings, forest, grass, or prairie fires.** Deaths resulting from burns sustained in transportation accidents, mining, quarrying, agricultural and forestry operations or machinery are not included in the 7,500 to 8,000 annual estimate. Very little is known about the number of persons who are permanently maimed or temporarily crippled because of fire burns.

In addition to the annual figure of 7,500 to 8,000 deaths given above, there are other deaths in which burns or fires contributed directly or indirectly. For example, suicide and homicide from burns or fires are excluded from the figure. Also excluded are fatalities in which fire was a contributory rather than the underlying cause of death. In selecting one cause of death for primary tabulations, National Office of Vital Statistics classification is made according to the external agent involved in the accident, *i.e.,* motor vehicles, mining, quarrying, agricultural, and forestry operations or machinery, even though burns or fires are reported in connection with such accidental deaths. Consequently, deaths resulting from burns sustained in a railway accident, for example, are counted as deaths in a railway accident.

An indication of the number of deaths which resulted from fires or burns occurring in such types of accidents is shown in Table 2. Inclusion of deaths from burns in such accidents would increase the annual total of burn and fire fatalities to between 11,000 and 12,000.

Additional deaths due to fires may be lost from the tabulations because the person who completes the death certificate

*The word "Conflagration" as used by the National Office of Vital Statistics should not be confused with its use in fire protection parlance, where it applies to sweeping fires that spread beyond control to destroy cities or large areas of built-up property.

...when the two upper floors collapsed. In 1950 27 firemen were killed in line of duty according to a partial NFPA survey of 572 cities in the U. S.

TABLE I

DEATH RATES FOR CONFLAGRATION AND BURNS (COMBINED) BY AGE, RACE, AND SEX: UNITED STATES, 1935, 1940, AND 1948

(Rates per 100,000 estimated midyear population in each specified group)

Year, Race, and Sex	All Ages[1]	Under 1 Year	1-4 Years	5-14 Years	15-24 Years	25-34 Years	35-44 Years	45-54 Years	55-64 Years	65-74 Years	75-84 Years	85 Years and Over
1948[2]	5.2	10.4	10.7	3.1	2.0	2.8	3.8	4.5	5.9	11.5	24.9	60.8
White—Male	5.1	9.1	7.8	2.3	1.8	3.1	4.4	5.3	6.2	11.8	25.4	66.3
White—Female	3.7	7.2	9.0	2.6	1.5	1.6	2.3	2.2	3.4	7.6	18.9	46.4
Nonwhite—Male	13.5	23.4	23.1	5.7	4.4	8.9	11.2	16.8	23.4	38.9	69.1	159.1
Nonwhite—Female	11.9	32.3	30.1	9.9	4.2	5.0	6.1	8.7	17.2	37.7	49.5	63.6
1940[2]	5.7	13.8	15.1	3.2	2.9	3.7	3.5	4.3	6.4	12.3	30.3	67.2
White—Male	5.1	11.0	13.0	2.1	2.4	3.6	4.0	4.7	6.4	10.6	25.4	55.5
White—Female	4.4	10.0	13.1	3.4	1.8	2.3	2.3	2.6	4.0	10.1	28.5	52.3
Nonwhite—Male	14.0	41.7	28.4	4.9	8.5	13.0	9.6	12.1	21.6	37.8	72.1	162.8
Nonwhite—Female	13.3	34.4	30.0	8.5	9.5	7.3	4.3	9.6	19.4	43.6	89.9	203.0
1935	5.7	12.2	19.0	3.8	2.4	3.3	3.6	4.6	6.1	12.1	27.1	64.4
White—Male	5.0	10.8	15.0	2.2	2.3	3.4	4.3	4.8	5.2	10.7	23.5	48.8
White—Female	5.1	9.7	18.8	4.3	2.2	2.4	2.2	3.0	5.5	10.6	26.0	55.1
Nonwhite—Male	10.4	21.9	27.7	4.6	4.7	8.4	8.3	9.7	13.3	28.0	65.6	160.6
Nonwhite—Female	12.8	29.8	40.4	12.0	3.1	5.9	6.5	12.4	18.1	38.0	64.0	179.2

[1] Figures for age "Not stated" included in the total, but not distributed among the specified age groups.

[2] Exclusive of deaths among armed forces overseas. Rates based on population excluding armed forces overseas.

TABLE 2

NUMBER OF DEATHS FROM SPECIFIED TYPES OF ACCIDENTS, AND ESTIMATED NUMBER OF DEATHS IN WHICH BURNS WERE AN ASSOCIATED CAUSE OF DEATH: UNITED STATES, 1948

Cause of Death	Total Number of Deaths	Per Cent Due to Burns[1]	Estimated Number of Deaths Due to Burns Received in Accidents
TOTAL	43,403	9.0	3,910
Railway accidents	2,502	3.8	100
Motor-vehicle accidents	32,259	7.9	2,550
Water-transport accidents	1,364	3.5	50
Air-transport accidents	1,912	44.8	860
Accidents in mines and quarries	1,348	6.8	90
Agricultural and forestry accidents	2,294	6.3	140
Other accidents involving machinery	1,240	8.1	100
Streetcar and other road transport	484	4.8	20

[1] Based on nature of injury tabulation of a 10-percent sample of death certificates, 1948.

fails to state that the fatal injury was incurred in a fire. However, the number so lost is probably small because fire injuries and burns usually impress themselves on the memory and are reported on the death certificates.

Although the number of deaths classified under the titles of *burns* and *conflagrations* may underestimate the loss of life from fire, there are included in the figures a number of deaths from burns due to molten metals, boiling liquids, acids, steam, and radiation. It is estimated that about 3 percent of the deaths from *burns,* except *conflagration,* are of this nature, which would reduce the total estimated fire deaths in 1948 by about 150. Beginning with mortality data for 1949, deaths from nonfire burns are classified separately from those due to fire burns.

To summarize, 7,700 lives were lost in 1948 as a direct consequence of fire and 3,900 persons died because of burns sustained in other kinds of accidents.* Also, the number of deaths from *burns* other than fire burns, and hot objects, which is included with fire *burns,* is very small.

Age, Race and Sex of Fire Casualties

Old people and preschool children are the principal victims of fires. The combined death rate for *conflagration* and *burns* is about 10 per 100,000 population under 5 years old. At the next older age group, 5 to 14 years, the rate is 3 per 100,000. From 15 to 34 years it ranges between 2 and 3 per 100,000. After that it goes up with each succeeding age group. For 65 to 74-year-olds, it is 11.5; for persons 75 to 84, it is 24.9; and, for those 85 or over, the rate is 60.8. (See Table 1 and Figure 1.)

Among the causes of the high rates of both the lower and upper portions of the age span must be inability to fight fires or to get away from fires, ineptness at handling combustible materials, and, perhaps for the aged, delayed reaction to the stimulus of a hot object or fire.

There is a striking difference between white and nonwhite groups in mortality from both *burns* and *conflagrations.* Depending on age of the victims, the death

*EDITOR'S NOTE: The NFPA has, in recent years, estimated that between 10,000 and 12,000 persons died annually due to hostile fires of all kinds in the United States. These figures confirm these estimates.

TABLE 3

DEATHS AND DEATH RATES FOR CONFLAGRATIONS AND ACCIDENTAL BURNS: UNITED STATES AND EACH STATE, 1942, 1947, AND 1948

(By place of residence. Exclusive of deaths among armed forces overseas. Rates per 100,000 estimated total midyear population present in area)

Area	CONFLAGRATION						ACCIDENTAL BURNS (EXCEPT CONFLAGRATION)					
	Number			Rate			Number			Rate		
	1948	1947	1942	1948	1947	1942	1948	1947	1942	1948	1947	1942
UNITED STATES	3,075	3,315	2,761	2.1	2.3	2.1	4,593	4,685	5,159	3.1	3.3	3.9
Alabama	95	73	28	3.3	2.6	1.0	155	172	198	5.3	6.1	7.0
Arizona	22	24	8	3.1	3.7	1.3	35	30	33	5.0	4.7	5.5
Arkansas	69	85	37	3.6	4.4	1.9	111	86	84	5.7	4.5	4.4
California	177	193	169	1.7	2.0	2.1	279	235	256	2.7	2.4	3.3
Colorado	46	17	5	3.8	1.5	0.4	27	29	40	2.3	2.5	3.5
Connecticut	24	21	33	1.2	1.1	1.9	35	36	52	1.8	1.8	2.9
Delaware	15	9	7	5.0	3.1	2.6	10	15	15	3.3	5.2	5.6
District of Columbia	14	9	21	1.6	1.0	2.5	37	19	33	4.3	2.2	4.0
Florida	38	36	31	1.6	1.5	1.4	73	101	87	3.0	4.3	4.1
Georgia	61	82	49	1.9	2.6	1.5	166	157	211	5.2	5.0	6.6
Idaho	8	15	9	1.4	2.9	1.7	18	17	21	3.1	3.2	4.0
Illinois	193	162	86	2.3	1.9	1.1	224	211	228	2.7	2.5	2.9
Indiana	79	63	41	2.0	1.6	1.2	105	117	155	2.7	3.1	4.4
Iowa	55	45	30	2.1	1.7	1.2	68	79	74	2.6	3.0	3.0
Kansas	58	38	32	3.1	2.0	1.8	59	59	71	3.1	3.1	3.9
Kentucky	77	72	57	2.7	2.6	2.1	125	143	165	4.4	5.1	5.9
Louisiana	84	62	31	3.2	2.4	1.2	125	124	128	4.8	4.9	5.1
Maine	30	36	25	3.3	4.1	3.0	23	17	33	2.6	1.9	4.0
Maryland	60	40	49	2.8	1.9	2.5	61	79	66	2.8	3.7	3.3
Massachusetts	54	47	478	1.2	1.0	11.1	103	103	123	2.2	2.2	2.9
Michigan	141	93	128	2.3	1.5	2.4	162	191	150	2.6	3.1	2.8
Minnesota	62	60	43	2.1	2.1	1.6	69	62	65	2.4	2.1	2.4
Mississippi	70	77	56	3.3	3.7	2.4	144	148	148	6.8	7.1	6.5
Missouri	54	85	92	1.4	2.2	2.4	153	184	140	3.9	4.7	3.6
Montana	15	16	10	2.9	3.3	1.9	16	25	18	3.1	5.1	3.4
Nebraska	37	21	6	2.9	1.6	0.5	39	47	54	3.0	3.7	4.3
Nevada	8	12	5	4.9	8.6	3.8	8	10	11	4.9	7.2	8.4
New Hampshire	13	14	13	2.5	2.6	2.7	12	16	21	2.3	3.0	4.3
New Jersey	82	87	70	1.7	1.9	1.7	118	99	116	2.5	2.1	2.8
New Mexico	18	15	8	3.2	2.7	1.5	26	22	18	4.6	4.0	3.4
New York	191	198	200	1.3	1.4	1.5	291	303	332	2.0	2.1	2.5
North Carolina	118	93	63	3.1	2.5	1.7	126	132	171	3.3	3.6	4.7
North Dakota	20	18	5	3.4	3.3	0.9	18	20	22	3.1	3.7	3.8
Ohio	147	155	144	1.9	2.0	2.1	230	243	241	2.9	3.2	3.5
Oklahoma	53	38	36	2.3	1.7	1.7	109	90	119	4.7	3.9	5.7
Oregon	44	31	49	2.7	2.0	4.2	43	40	50	2.6	2.6	4.3
Pennsylvania	145	137	146	1.4	1.3	1.5	248	264	333	2.4	2.5	3.4
Rhode Island	13	9	12	1.7	1.2	1.7	14	6	17	1.9	0.8	2.4
South Carolina	46	58	54	2.3	3.0	2.7	96	98	143	4.8	5.0	7.1
South Dakota	10	6	4	1.6	1.0	0.7	16	15	26	2.6	2.6	4.5
Tennessee	85	87	68	2.7	2.8	2.3	100	107	137	3.1	3.5	4.7
Texas	174	588	110	2.4	8.3	1.6	354	406	348	4.8	5.7	5.2
Utah	2	7	6	0.3	1.1	1.0	14	13	17	2.1	2.0	2.8
Vermont	19	7	7	5.2	1.9	2.0	15	13	7	4.1	3.6	2.0
Virginia	75	117	75	2.5	3.9	2.5	128	118	114	4.2	3.9	3.8
Washington	71	60	37	2.9	2.5	1.9	48	44	64	1.9	1.9	3.3
West Virginia	45	41	36	2.4	2.2	1.9	82	68	113	4.3	3.6	6.0
Wisconsin	55	48	38	1.6	1.5	1.3	59	63	73	1.8	1.9	2.4
Wyoming	5	8	14	1.8	3.0	5.0	16	9	18	5.6	3.4	6.5

DEATH RATES FOR CONFLAGRATION AND BURNS BY AGE FOR WHITE AND NONWHITE GROUPS: UNITED STATES, 1948

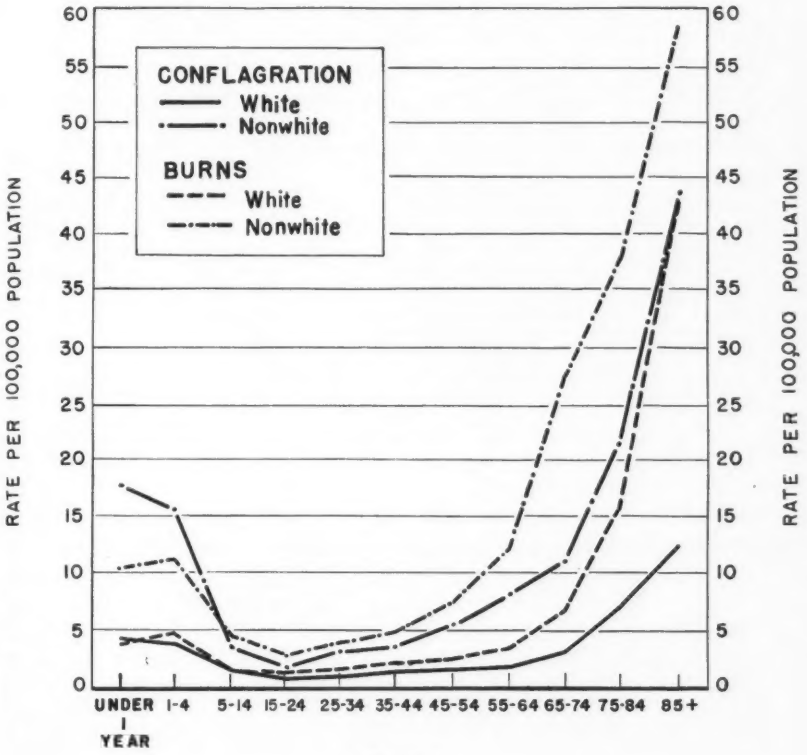


Figure 1

rates for nonwhite groups are from two to four times larger than for whites of the same age. The difference between the race groups seems to be greater for females than for males. The racial variation in mortality from *burns* and *conflagrations* is very likely associated with differences in housing, occupation, and economic status. The clapboard shanty with two rooms heated by wood or oil-burning stoves has more of the requisites for a conflagration than a bungalow with basement furnace, electric range and asphalt shingles. Being exposed to the risk of burns for longer periods, janitors, furnace men, cooks, and laundresses would be more subject to higher death rates from burns than retail sales clerks, lawyers and lathe-operators.

Except among children under 15 years, the death rates for both *burns* and *conflagrations* are higher for men than for women. This is true for both white and nonwhite groups. The difference is more pronounced for *conflagrations* involving

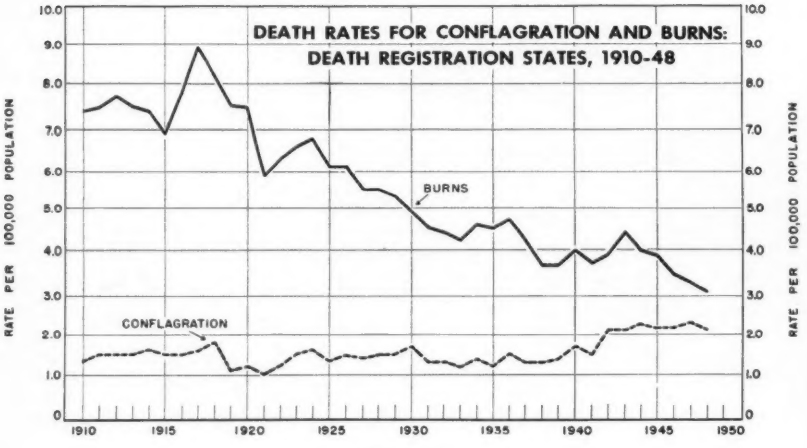


Figure 2

DEATH RATES FOR CONFLAGRATION BY STATES: UNITED STATES, 1948
(RATES PER 100,000 ESTIMATED POPULATION)

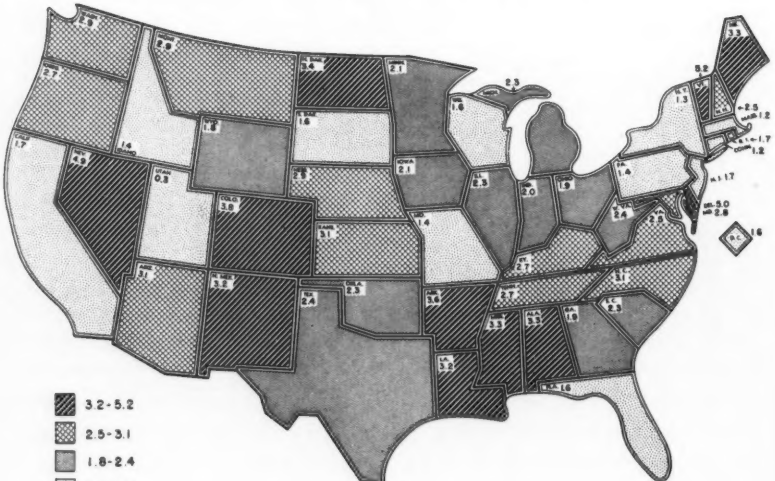


Figure 3

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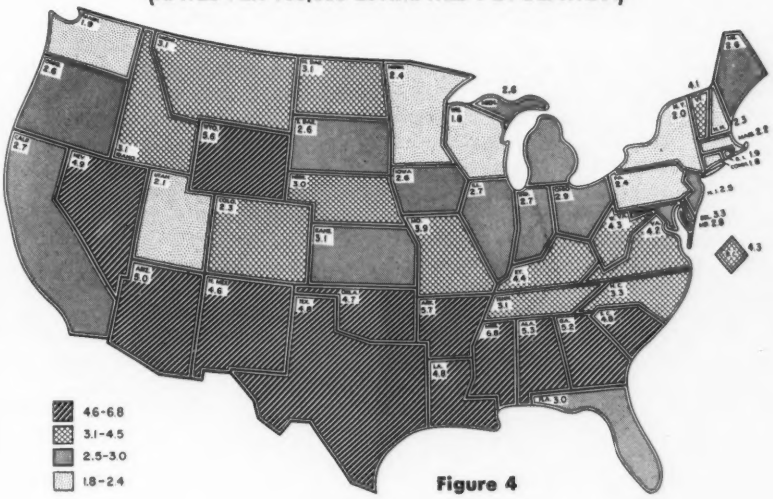

Figure 4

persons of 45 years and older, where the rates are two to three times higher for men than for women. For reasons which are not apparent, the death rates for girls of 1 to 14 years are higher than the rates for boys. The difference may be partly associated with differences in clothing, since skirts of rayon or cotton are quicker to catch fire and burn than woolen trousers.

Age-specific death rates for *burns* and *conflagrations* for white and nonwhite groups by sex for the years 1935, 1940, and 1948 are shown in Table 1.

Trend of the Death Rate

In the 16-year period that the U. S. death-registration area has included all of the 48 states and the District of Columbia, the death rate for *burns* (except *conflagrations*) has decreased from 4.2 to 3.1 per 100,000 population, or 26 percent. On the other hand, the death rate for *conflagration* has increased from 1.2 to 2.1 in that period. As a result of these opposing movements in the two rates, the death rate for *burns* and *conflagrations* combined has remained almost unchanged, except for a slight elevation during World War II.

Prior to 1933 the death rate for *burns* was higher, *i.e.*, about 7.5 between 1910 and 1919 and ranging from 5.3 to 6.8 for the expanding death-registration area from 1920 to 1929. The rate for *conflagration* fluctuated from 1.1 to 1.6 during most of this period.

As in World War II, an increase was observed in 1917 and 1918, particularly in mortality from *burns*. It seems possible that the increases in wartime are associated with the accelerated industrial activity and with the increased employment of women outside the home with consequent increase in the numbers of children and aged left alone at home.

Death Rates by State

Variation between the states is seen in the death rates for 1942, 1947 and 1948 by

place of residence for *burns* and *conflagration* shown in Table 3. The variation is more marked for *burns* than for *conflagrations*. In general, the highest death rates for both of these causes are those in the South. It seems likely that this is due chiefly to the large nonwhite population, for which the death rates for burns are high.

What differences there may be between urban and rural areas in mortality from *burns* and *conflagration* are undefined. It is probable that urban places have relatively fewer deaths from fire than rural areas because of the accessibility of facilities for combatting fires in cities. The only available support for this theory is the observation that rates for states with large urban populations are lower than the rates for less urbanized states. Rates for Connecticut, Massachusetts, Rhode Island, New York, and New Jersey, which have large urban populations, are low; for Maine, Vermont and West Virginia, which are principally rural, they are higher than the national rate. However, the low rates for Iowa, Minnesota, Utah, and Wisconsin, which are chiefly agricultural states with high proportions of their populations in rural areas, do not support this hypothesis.

The effect of two disasters can be seen on the rates for two states. The rate of 11.1 for Massachusetts in 1942 reflects the Cocoanut Grove nightclub fire, which the NFPA reports took 492 lives.* The effects of the ship explosion and fire in Texas City, Texas are seen in the death rates for both *burns* and *conflagrations* in 1947.†

*See NFPA pamphlet No. E117.
†See July 1947 NFPA QUARTERLY.

Types of Places

Although fires like the Atlanta hotel fire, the Hartford circus fire, and the Boston night club fire, in which one hundred or more are killed, are spectacular and horrifying, even more important in terms of the total annual number ot fire deaths are those in private homes. Almost daily in the newspapers, particularly in winter months, one reads "Five die as home burns," "Mother and infant perish after stove explodes." "Apartment gutted, three burned fatally." These persons killed by twos and threes each day in cities or towns from Brunswick, Maine to Bremerton, Washington mount up to totals far larger than the total burned or trampled to death when a circus tent ignited in 1944 and those killed in the Cocoanut Grove nightclub fire in 1942.

The distribution of fire deaths by place of fire is shown in Table 4, based on a 10-percent sample of death certificates.

TABLE 4

FIRE DEATHS BY PLACE

	Total	Public Place	Home	Industrial Place	Farm
Conflagration					
1948....	100.0	4.1	94.0	1.5	0.4
1947....	100.0	4.7	91.5	1.9	1.9
1946....	100.0	9.4	83.9	4.7	2.1
Burns					
1948....	100.0	5.9	85.7	7.6	0.8
1947....	100.0	5.9	83.0	10.0	1.1
1946....	100.0	7.4	77.2	12.7	2.8

Note: Deaths from *burns* in unspecified places amounted to 25-30 percent; from *conflagrations*, 10-20 percent. These are distributed proportionately in the percentages above.

It is rather surprising to see what a large proportion (77 to 94 percent) of deaths from both *burns* and *conflagrations* are accounted for by fires in homes. The percentage of fire casualties resulting from farm fires is extremely small, probably be-

RATE PER 100,000 POPULATION

cause farm homes are included with homes rather than farms. While the distributions for 1947 and 1948 are very similar to each other, the proportions for 1946 are slightly different since the proportion of deaths from home fires was about 8 percent less than in the next two years.

Seasonality of Fire Casualties

Winter is the season when fire deaths are at a peak. The curve of the death rates by month is U-shaped. January and February are the months when death rates for both *conflagration* and *burns* are highest. In 1948, as in other years, the death rates decreased in the spring months with the coming of moderate weather, reaching a low point in June. Between June and September when the need for fires is at its minimum, death rates remained low, although the death rate for *conflagration* moved upward in September. As autumn advanced, the rates rose sharply, with the sharpest rise occurring between November and December. In spite of the fire hazards associated with Christmas decorations, the death rates for both *burns* and *conflagrations* were not as high in December as in January, which suggests that the principal

DEATH RATES FOR CONFLAGRATION AND BURNS, BY MONTH OF DEATH: UNITED STATES, 1948

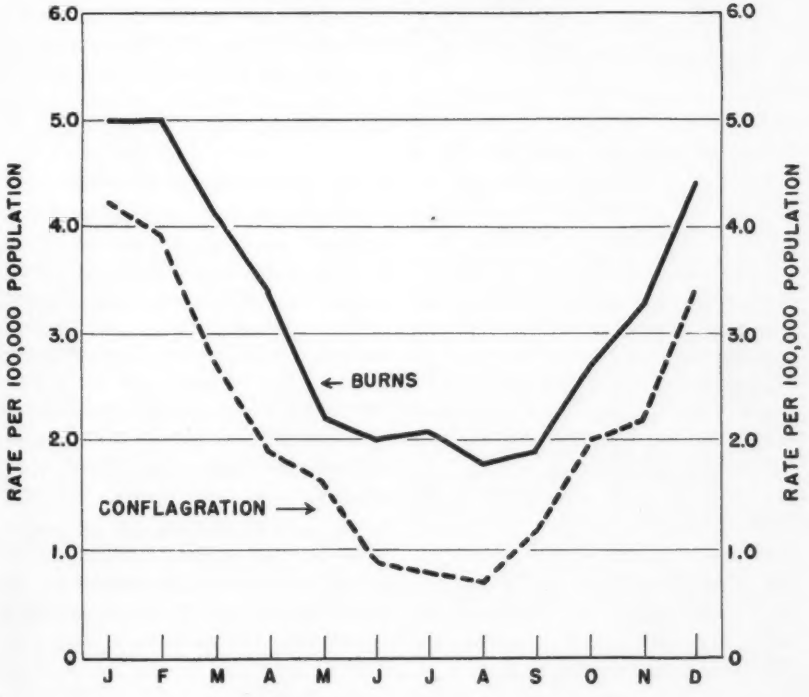

Figure 5

hazard from fire is associated with its use for heating purposes.

Nonfatal Burns

Data on the annual frequency of nonfatal, disabling burns are so limited as to be almost nonexistent. In the National Health Survey[1] of 1935-36, it was found that burns accounted for a rate of 0.6 disabled for one week or more per 1,000 persons. Burns made up 5 percent of all the accidental injuries reported.

Reports of accidents to school children in Kansas[2] indicate that 37, or 2.5 percent, were burns or scalds out of a total of 1,632 injuries requiring medical attention or resulting in absence from school for ½ day or more. (The student population covered was 116,576 in 1948, but reporting was admittedly deficient, particularly for out-of-school accidents.)

In three surveys of accidental injuries to farm persons conducted by the Bureau of Agricultural Economics[3] in 1946-1948, it was found that 1.3 out of every 1,000 farm residents lost 1 or more days from their regular activities because of burns or shock.

The report of the Oregon Department of State Fire Marshal[4] for 1947 lists 101 injuries in connection with fires in the state. In the same period fires caused 66 deaths. Twenty-one of the persons who incurred nonfatal injuries in fires were firemen fighting fires. Seven of the men suffered cuts or puncture wounds; five were burned; seven were overcome by smoke or poisoned by gas; two received other injuries.

Reporting on injuries from home accidents to life insurance policyholders who requested nursing service, Armstrong and Cole[5] state that burning substances, excluding electric burns, were the agent of injury in 13 percent of the total. For preschool children the proportion of injuries resulting from hot or burning substances was higher than for the whole group, namely 19 percent at ages under 5 years. Burns and scalds ranked first among the injuries to children under 5, with 39 percent of the total being of this nature. For youngsters 5 to 14 years old, burns and scalds ranked second, accounting for 24 percent of the injuries. Burns and scalds accounted for 21 to 23 percent of the total number of injuries to persons of all ages. (The total number of cases is not given.)

A special summary[6] of diagnoses of crippled children on the registers of 44 states and the District of Columbia made in 1944 showed that 7,521 of the total numbering 341,022 were receiving care because of burns. A less complete study in 1948 showed that nearly the same proportion, *i.e.*, 2 percent, of crippled children served by state programs for crippled children were classified as burn injuries.

Definitions of Fire Casualty

The discussion of what to include in counting fire casualties, the question of whether burns from stoves, open household fires, and bonfires are fire injuries, indicates lack of agreement on what is regarded as a fire injury. It points to the need for basic definitions of fire and fire injury that are acceptable to the collectors and users of the data, *i.e.*, fire protection agencies, safety groups, and public health people.

The same kind of problem was encountered in the compilation of motor-vehicle accident statistics before 1940. In that year, the foundation for the compilation of comparable data on traffic accidents was laid by agreement among the interested groups on definitions of motor-vehicle accidents, with promulgation of uniform

definitions by the National Conference on Uniform Traffic Accident Statistics in 1942.

The Subcommittee on Statistics, the President's Conference on Fire Prevention, which met in May 1947, had the assignment of studying possible methods of improving the collection and distribution of statistics of loss of life and serious injury by fire. It found that data on fire casualties compiled by various agencies were not in agreement. The differences were due to variations in what were regarded as fire casualties. Higher estimates were released by insurance groups than vital statistics offices because the former included deaths from pneumonia or exposure associated with fire, and injuries incurred in motor-vehicle accidents in which fire-fighting equipment en route to fires was involved. The validity of including such deaths in calculations of fire losses is debatable since fire is only indirectly associated with the fatal injury or disease.

The first assignment has taken almost the exclusive attention of the Subcommittee since it was organized. In 1948, when the President's Conference concluded its activities, the committee was reconstituted as the Committee on Fire Casualty Statistics of the National Fire Protection Association. A Definition of Fire Casualty and a Location Classification of Fires Responsible for Fire Casualties agreed upon by the NFPA Committee on Fire Casualty Statistics in May, 1950 were tentatively adopted by the NFPA at its 1951 Annual Meeting. It is planned to give these definitions a trial by fire marshals and other fire prevention agencies. The tentative definitions are published in the NFPA 1951 *Advance Reports.*(7)

It will be seen that this definition is in agreement with the practice now followed in Vital Statistics Offices for compiling mortality statistics on fires. If used for compilations of nonfatal injuries it will give data comparable to those regularly tabulated from death certificates. Whether the definition and explanatory material on inclusions are complete enough to guide local fire authorities in the compilation of uniform and comparable data can be told only by giving them a trial.

Because of the paucity of data on the types of fire resulting in death and the absence of statistics on nonfatal injuries, it is hoped that a data collection mechanism will be put into operation and the definitions and location classification used.

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Aircraft Carrier Pushbutton Fire Fighting*

By Richard L. Tuve

Naval Research Laboratory, Washington, D. C.

The so-called pushbutton warfare technique has almost reached the state of Mark Twain's classic description of the weather: "Everybody talks about it but nobody does anything about it!" The foot soldiers, the artillery, the guns from the big battlewagons, torpedos and aircraft bombs directed and launched by human operators are still the most effective offensive weapons of war.

In the *defensive* aspects of war, however, a new use has been made of "pushbutton warfare" — in the war against fire. Just prior to the close of hostilities in 1945, a new system of fire protection, born in the laboratory, successfully passed its "mock-up" trials for shipboard installation. The trials consisted of rigging fog-foam nozzles, proportioning pumps and water lines in exactly the same manner in which they would be installed for fire protection in an aircraft carrier hangar deck but using, instead, an open flat ground area 60 feet by 200 feet at a large Naval Air Station. Unserviceable and junked aircraft of various types were pulled into this entire area, drenched with gasoline, and set afire. Extinguishment was rapid and complete with the new "High-Capacity Fog-Foam System" as it was later named.

In general, this system consists of a piped installation using water from the fire mains of the ship. The water passes through a 1000 gpm positive displacement water-motor proportioner† where the correct amount of foam-forming concentrate or liquid stabilizer is added from a 300-gallon tank reservoir. The resulting 6% solution is then piped to the hazardous areas in either the hangar deck and/or the flight deck above, where both portable and and stationary fog-foam nozzles can produce large "snowstorms" and solid streams of mechanical foam, simultaneously covering areas of hundreds of square feet.

Early equipment for accomplishing this task was crude in design and required elaborate communication systems between various components of the equipment to assure successful operation. Manual activation of the installation required many precious minutes and a graduate chemical engineer was needed each time the alarm was sounded if the fire fighting party could expect to find good quality foam available when the nozzles were manned.

In cooperation with the Damage Control Section of the Bureau of Ships, the Naval Research Laboratory has continued its study and research on the system even after its first installation aboard ship in 1946. Detailed engineering study of each component of the system has resulted in an almost automatic, and, we hope, foolproof, operation of emergency equipment embodying mechanical, electrical and hydraulic energy transfer.

*Based on a talk presented at the 1951 Annual Meeting of the NFPA held in Detroit, Michigan, on May 7-11, 1951. (Program Item 105.)

†See NFPA Standards for Foam Extinguishing Systems, NFPA No. 11, 1951, Appendix, page 43.

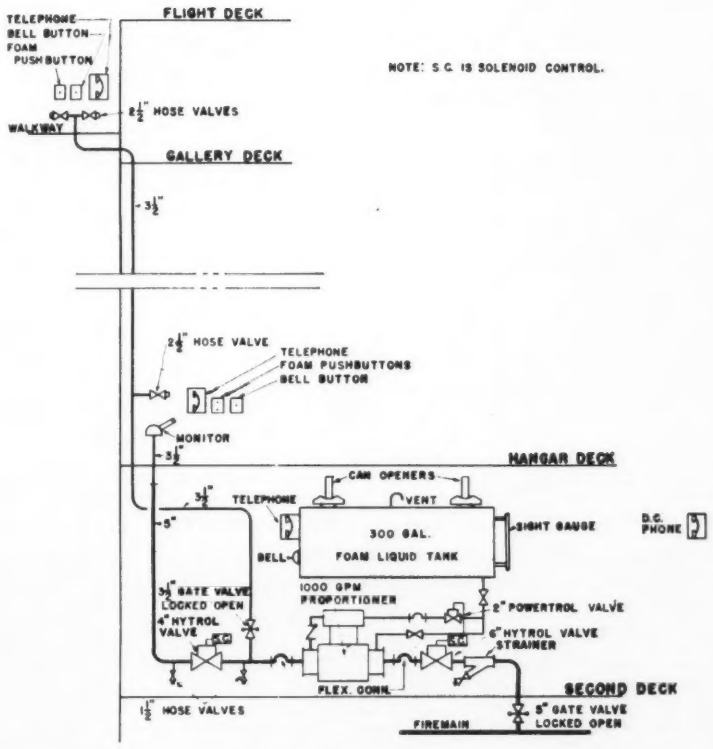


Figure 1. Schematic drawing of aircraft carrier High-capacity Fog-Foam System, showing injection station and dry type dual riser.

Figure 1 is a schematic elevation drawing of the apparatus and piping arrangement of contemporary installations of the High-Capacity Fog-Foam System. Water at 150 psi is continuously available at the 6-inch hytrol valve on the second deck. When the electrical circuit is closed by any one of the foam pushbuttons installed at the hangar deck, flight deck, or in the "conflagration station," which is a completely enclosed and protected control cubicle elevated above the hangar deck, the solenoid control (Figure 2) operates to rotate the pilot valve controlling the opening of the hytrol and power-trol valves (Figure 4) in the water and foam liquid input lines. Water flowing through the water-motor drives the directly-coupled foam liquid pump injecting the correct proportion of foam-forming concentrate

into the downstream water line.* The entire proportioning system is installed under the three-by-seven foot 300-gallon tank (Figure 3).

In order to make certain that the 300-gallon foam liquid concentrate tank is kept full during full capacity operation of the system, there are two quick-opening devices installed on the tank top. (See Figure 5.) These units pierce a 5-gallon foam liquid can in two places (for liquid withdrawal and air venting), discharging the contents into the tank in six seconds.

The condition of a given system (there may be several installations spaced the length of a carrier) is immediately seen by colored indicating lights showing at the

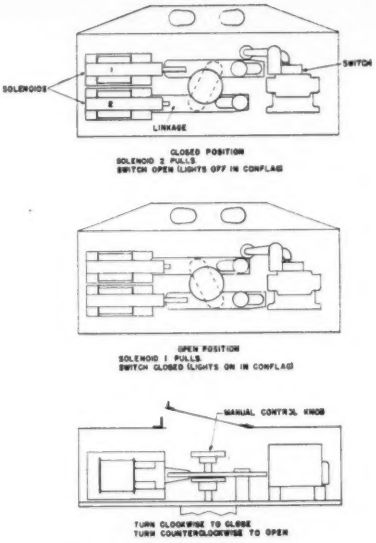


Figure 2. Solenoid Control which operates to rotate the pilot valve controlling the hytrol and power-trol valves (see Figure 3).

*"Fire Fighting at Sea," by Harold J. Burke, 1949 Proceedings, Society of Naval Architects and Marine Engineers, 29 West 39th Street, New York, New York.

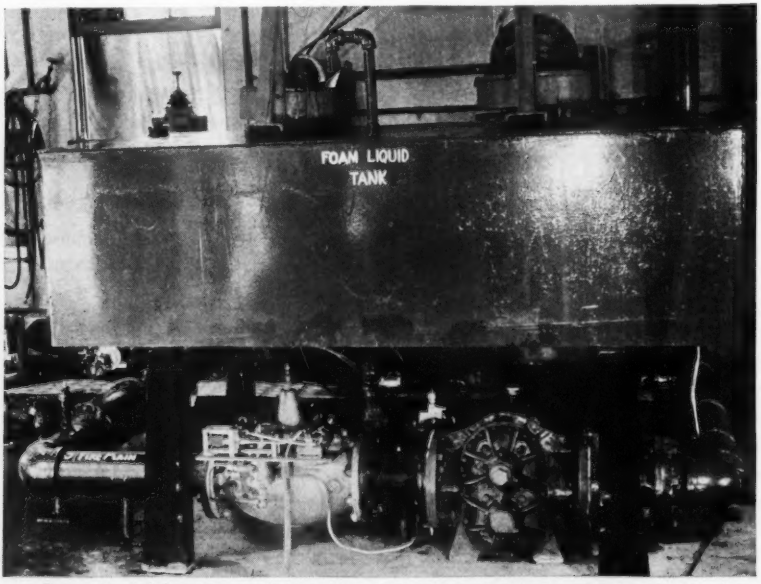
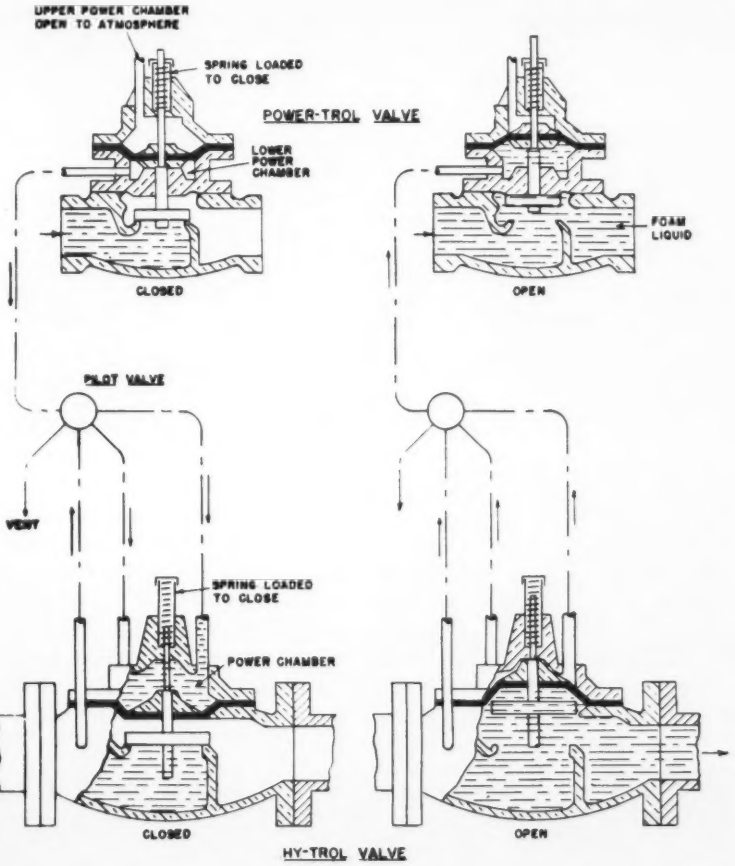


Figure 3. A laboratory prototype of a carrier foam liquid proportioning station. The foam liquid tank has a 300-gallon capacity. Note water-motor proportioner mounted under tank.



Figuere 4. Power-trol and Hytrol valves used in High Capacity Fog-Foam System aboard Naval Aircráft carriers. (See Figure 1 for location of valves.)

various control panels. In case of power failure the system is immediately operable throughout by manual control.

Various water-flushing valves and lines are connected to the system so that all traces of decomposable foam-forming solution may be flushed out with clean water after use. The installation is returned to a "ready" position by draining all piping downstream of the proportioning station. Within 7 seconds after pushbutton activation of this "dry" system, foam can be produced with water rates of 500 gpm at the most remote flight deck station, usually about 100 feet distant.

In keeping with the excellent precedent set during World War II, of training all fire fighting personnel in the correct use of shipboard damage control methods and devices, the Bureau of Ships has constructed

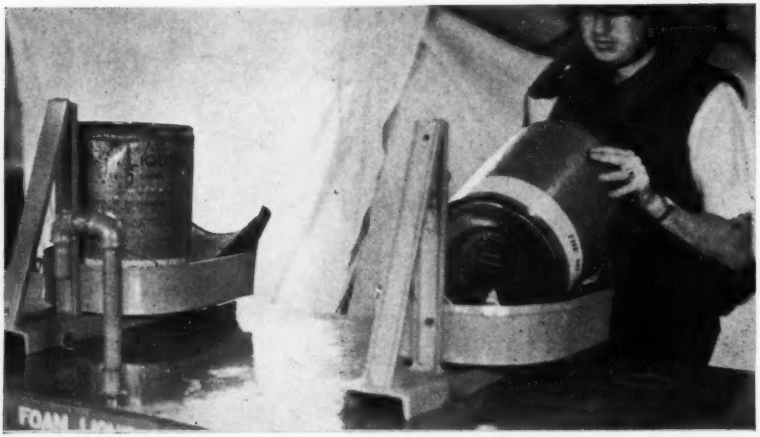


Figure 5. Two quick-opening devices for foam liquid cans are installed on the top of the bulk foam liquid tank to keep the system in full operation.

in concrete at the Bureau of Personnel's Philadelphia Damage Control School a typical single H. C. Fog-Foam System carrier installation. Figure 6 shows the foam pushbutton station as it is installed on the flight deck walkway on a carrier. A sound-powered telephone station is available for relaying instructions from other stations to the men on the hoseline which attaches at the riser near by. Immediately behind this hose station a concrete area is available for practice on simulated carrier deck crash fires. Gasoline spill fires involving areas of about 30 by 60 feet are repeatedly put out in less than one minute with three to five men on one 2½-inch hoseline using

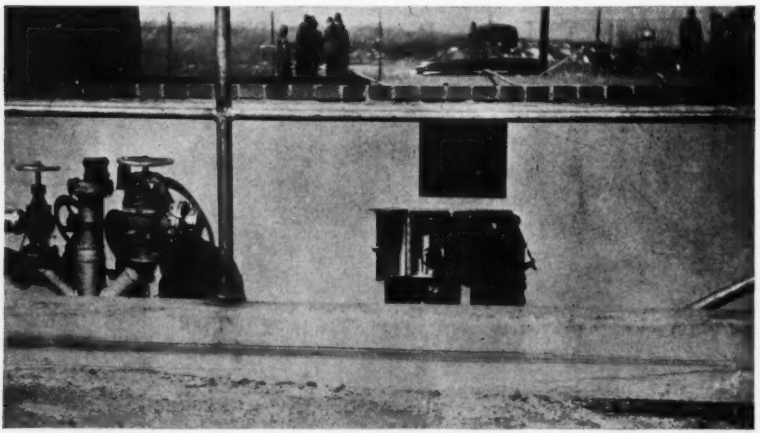


Figure 6. Realistic fire training at Navy shore stations plays a big role in shipboard efficiency. This simulated flight deck foam pushbutton station is the way it is installed on the carrier walkway (see Figure 1).

220 gpm water for foam production. All instructional operations are conducted with proportioning equipment and remote pushbutton activation which evolved from the Naval Research Laboratory studies.

It should be mentioned that the System has already received its initial battle exposure. One of our carriers on war task duty near Korea has had a number of gasoline fires aboard her since last September. The High-Capacity Fog-Foam System has operated admirably in each case, expediently controlling and extinguishing each fire. The most severe test was a fire involving a crashed aircraft and others on the flight deck loaded with jellied gasoline bombs, requiring only nine minutes for a complete "out."

Suppression of Fuel-Air Explosions*

By W. G. Glendinning and A. M. MacLennan
Royal Aircraft Establishment

Synopsis

The problem of preventing explosion (and resultant fire) of aircraft fuel tanks when penetrated by incendiary bullets has received considerable attention. One method to cope with this problem has been an inert gas system designed to keep the air-fuel vapor mixture above the liquid non-explosive and nonflammable.

A new concept for preventing fuel tank explosions under such conditions (and applicable to other conditions) is reviewed herein. It is known as the "Explosion Suppression System" because it actually suppresses an explosion during its initial stage immediately following ignition.

The system utilizes a detecting device which picks up the pressure rise in the early stages of an explosion and ignites a detonator which, in turn, scatters combustion inhibiting fluid throughout the fuel tank (or similar vessel). This suppresses explosion forces before damage is caused to the tank.

Oscillograph records of the experimental research so far conducted indicate operation in 10 milliseconds and pressure control in the order of 3 psi or less.

Mr. Glendinning presenting this paper at the 55th NFPA Annual Meeting.

Suppression of explosions sounds very ambitious and I would like to point out that it applies only to explosions such as occur when a flammable mixture of, say, gasoline vapor and air is ignited and not to the ignition of propellants and explosive charges used in shells and bombs.

During an investigation into the pressures developed by gasoline vapor and kerosine mist explosions, we were struck by the comparatively slow rise of pressure in the early stages of the explosion — an initial rise of pressure of one pound per

*Based on a talk presented at the 55th Annual Meeting of the National Fire Protection Association held in Detroit, Mich., May 7-11, 1951. (Program Item No. 61.) The talk was presented with permission of the Chief Scientist, British Ministry of Supply. Opinions expressed are those of the authors and may not represent those of the Ministry.

square inch in 10 or more milliseconds. This focussed our attention on the possibility of quenching the combustion during this initial period and before the pressure could rise to a dangerous value.

Our preliminary tests were done in the laboratory in a vessel of approximately 5 gallons capacity. This was fitted with a pressure switch, consisting of sensitive metal bellows, connected to a detonator immersed in carbon tetrachloride in a glass container. (See Figure 1.)

The vessel was filled with an explosive mixture which was ignited by an electric spark. The initial pressure rise of about ½ psi triggered the switch thereby operating the detonator and dispersing the extinguishant. The sequence of events was followed by means of oscillograph recording equipment.

In the first test of kerosine, spray-air mixture was used and an unsuppressed explosion gave a pressure rise of approximately 60 psi. When, in the next test, the explosion suppression device was brought into action, the pressure rise was limited to 1½ psi. This was encouraging, but we were not satisfied until we had dealt with a vapor-air explosion which we knew developed its pressure much more rapidly. In the laboratory we used hexane vapor-air mixtures which have similar explosion characteristics to gasoline vapor-air mixtures.

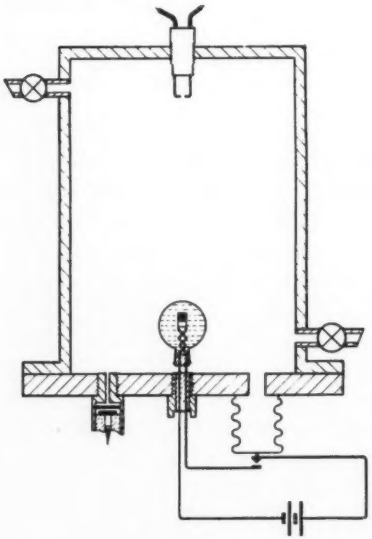


Figure 1. Vessel used in preliminary laboratory tests at the Royal Aircraft Establishment.

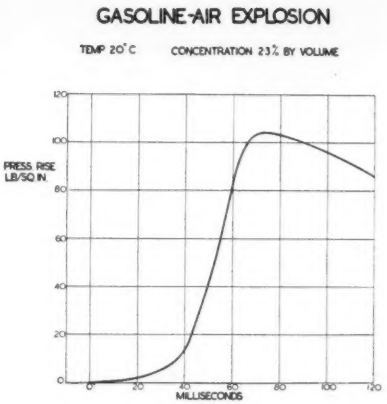


Figure 2. Normal (unsuppressed) pressure rise of gasoline-air mixture shows relatively slow rise in the first 10 milliseconds.

The mixture used, slightly richer than stoichiometric,* was that which gives the maximum pressure rise and the maximum rate of use of pressure on ignition (approximately 105 psi in 50 milliseconds). This was successfully suppressed, the maximum pressure reached being again some 1½ psi. (See Figures 2 and 3.)

At this stage we made a high speed cinematographic record of hexane-air ex-

*The amount of oxygen (in air) and fuel vapor that will combine to form complete combustion.

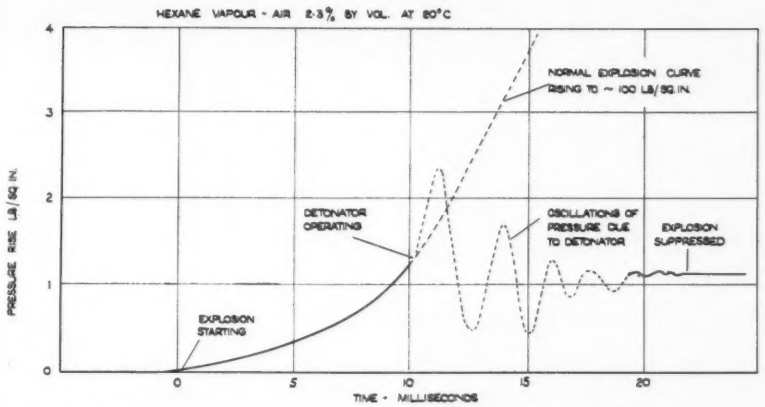


Figure 3. Oscillograph trace of a suppressed hexane vapor-air explosion.

plosions, one uncontrolled and one suppressed, using an explosion vessel of transparent plastic eight inches in diameter.

At this time, during his talk, Mr. Glendinning showed a slow motion film (one-sixtieth of the true speed) of these tests. In the photos of the uncontrolled explosion it was possible to observe the ignition by a spark, the spread of the spherical flame front throughout the vessel, the increase in luminosity as the peak pressure was reached, and the decrease as the temperature and pressure fell. This was followed by photos of a suppressed explosion which showed a small initial spread of flame, the disruption of the suppressant container, the rapid dispersal of carbon tetrachloride and the almost instantaneous quenching of the flame. The actual time from ignition to bursting of the suppressant container was 10 milliseconds and extinction was complete in 14 milliseconds.

We found close agreement between our pressure-time oscillograph records and the values calculated from the equation derived by Lewis and von Elbe:

$$n = \frac{P - Pi}{Pe - Pi}$$

where n = mass fraction of gas burnt
P = pressure due to burnt fraction
Pi = initial pressure
Pe = end pressure

using values of n calculated from measurements taken from the film at various time intervals.

Laboratory tests were done to test the efficiency of water as a suppressant. These showed that volume for volume it was at least as good as carbon tetrachloride and on a weight basis considerably better. However, in dealing with explosions in fuel tanks it is necessary to use a material which is miscible with the fuel and in the quantities used will not interfere with its combustion in an engine.

The quantity of material required for suppression is not greater than 10 cc. per gallon at normal atmospheric pressure and the amount required in the range from one to ¼ atmosphere is directly proportional to the pressure.

In other spaces, such as engine nacelles, baggage compartments (or where toxicity is of importance), it may be that water, with a suitable freezing point depressant, will be found most suitable.

In one successful test hexane was used as the extinguishant, its action being main-

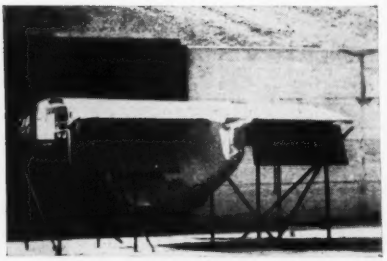
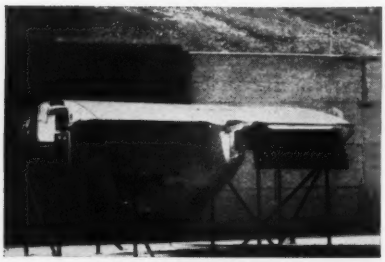


Figure 4.



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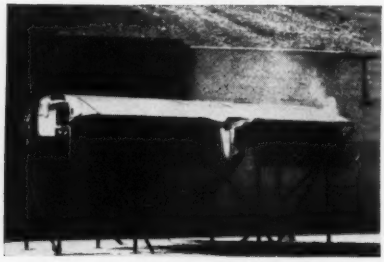


Figure 6.

Figures 4, 5 and 6. RAE sequence photos from a film (exposed at 100 frames per second) of a fuel cell protected with the explosion suppression device. The fuel cell contained a gasoline-kerosine explosive vapor-air mixture and was fired by .5 calibre incendiaries.

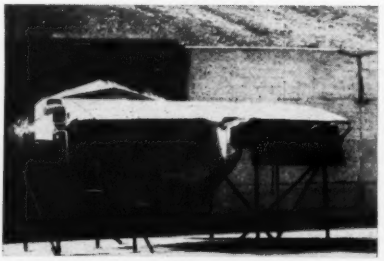


Figure 7.

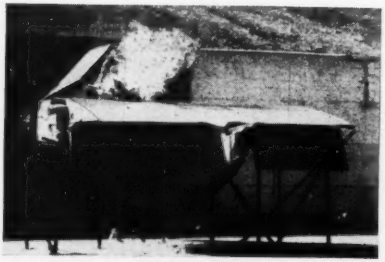


Figure 8.

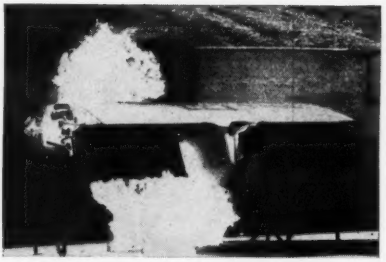


Figure 9.

Figures 7, 8 and 9. These RAE sequence photos (exposed similarly to those in Figures 4, 5 and 6) are of an identical fuel cell containing a similar explosive vapor-air gasoline-kerosine mixture and fired by .5 calibre incendiaries but this cell was *not* protected by the RAE explosion suppression device.

ly enrichment of the mixture above the limit of flammability.

It is not my intention to discuss at length the kinetics of extinction of the three substances used, but briefly, carbon tetrachloride is effective by a combined thermal and chemical deactivation, water is almost exclusively a thermal deactivator and hexane extinguishes mainly by raising the concentration of combustible above the upper limit of flammability.

Following the successful laboratory experiments, the Graviner Manufacturing

Co.* developed apparatus for large scale experimental work. The metal bellows used in the laboratory tests were replaced by diaphragm pressure switches sensitive only to very rapid rates of rise of pressure, and the glass containers by frangible bakelite bombs. This apparatus was successfully used to suppress spark ignited explosions in vessels up to 50 gallons capacity. In order to show the feasibility of the system in dealing with aircraft fuel tanks, it was necessary to show that explosions started by incendiary ammunition could be suppressed. A few successful tests were done with fuel containing explosive mixtures and fired by .303 calibre incendiary and, following these, a demonstration was staged at Farnborough from which the photographs reproduced from a 35-mm film and printed here were made. In these tests, .5 calibre incendiaries were used and the tanks contained a fuel blended from gasoline and kerosine in the proportions required to give an explosive vapor-air mixture above the fuel. (Figures 4 through 9.)

Measurements taken from high speed films of the bursting of the bakelite container have shown that the rate at which carbon tetrachloride is scattered over the first 12 inches traveled is of the order of 300 ft./sec., which is very much in excess of the flame speed of burning hydrocarbons. We think that this high rate of scatter may make it feasible to utilize the system of dispersal (1) to combat crash fires by blanketing engine exhaust systems and for flooding compartments into which fuel may leak from damaged pipes or tanks, and (2) to combat fires in engine nacelles in which a high rate of air flow makes it impossible to maintain a sufficiently high concentration of extinguishment with the usual pressurized bottle and spray system. Consideration has been given to the application of this rapid method of dispersal of extinguishant in combating crash fires in which fractions of a second are of vital importance.

The emphasis has been on the hazard of aircraft explosions and fires, but it will be realized that the method is applicable to many industrial problems such as the protection of tanks containing fuel and other flammable liquids and equipment handling explosive dusts.

*Simmonds Aerocessories, Inc., Tarrytown, New York, is U. S. licensee for the Graviner Manufacturing Co., Ltd.

Butadiene Fire, Kobuta, Pa.

By W. F. Cullinane, G. F. Prince and E. J. Dean*

A potentially very serious fire occurred at 7:05 A.M. on March 6, 1951 in the refining section of Butadiene Unit No. 3 at the Kobuta, Pa. plant of Koppers Co., Inc. The primary cause was a leaking packing gland on a pump at a butadiene still. In attempting to change to the adjacent spare pump the operator opened a 6-inch valve without first closing a ½-inch bleeder valve in the line between the two pumps and approximately 4 inches from the 6-inch valve. The butadiene vapors released were probably ignited by an open flame at a chemical heater located 185 feet from this area. The fire burned for a total of 5½ hours and was finally extinguished after it had subsided by gradually cutting off the sources of fuel. Plant emergency organizations functioned well and the mutual aid from outside agencies was handled smoothly as outlined in a Disaster Plan.

The butadiene area of the Kobuta Plant is composed of four butadiene units which are the property of Reconstruction Finance Corporation, an instrumentality of the U. S. Government. The Rubber Program is administered by the Office of Rubber Reserve. These units were completed in 1943 and were operated by Koppers Company from the completion date to December 1, 1945 at which time they were placed in stand-by condition. In the Fall of 1950 the Office of Rubber Reserve requested that two of these units be reactivated and placed in operation. The first unit was placed on stream during the middle of November 1950 and the second unit during the middle of February 1951. The fire occurred in the second unit reactivated.

The purpose of the butadiene units is to convert ethyl alcohol to butadiene by catalytic oxidation. Each unit consists of an oxidation section of twelve converters and a distillation section of 14 columns. The columns are laid out in a line, spaced approximately 10 feet apart, and are separated from the converter section by a 2-story control room and compressor building. The raw material, intermediate and final product tanks are located on a tank pad approximately 30 feet from the distillation columns.

Fire Protection

The manually operated water spray system provides coverage in the tank pad area with one head above and one beneath each tank and with a water curtain between each row of tanks. The installation was made before the present NFPA standards were issued.* The orifices in the heads were originally 1/16-inch in diameter but were changed in 1944 to ⅛-inch to prevent plugging. The water is supplied from the Ohio River by 20,000 gpm pumps of which six are available. A three million gallon elevated emergency reservoir floats on the distribution system.

The fire fighting organization is the Fire and Safety Department and the 15-man fire brigade on each shift. The Kobuta Plant Fire and Safety Department consists

*W. F. Cullinane, Director of Fire and Safety, Kobuta Plant of Koppers Co., Inc.; G. F. Prince, Supervisor of Fire and Safety, Kobuta Plant; E. J. Dean, Division Safety Specialist, Chemical Division. Mr. Prince presented this report at the Industrial Session of the National Fire Protection Association Annual Meeting in Detroit, May 8, 1951. (Program Item No. 37.)

*NFPA Standard No. 15, Water Spray Systems for Fire Protection.

Implementation of a disaster plan was a major factor in confinement of this potentially disastrous fire to one of three adjacent butadiene units at Kobuta, Pa., March 6. Abundant water supplies from large mains permitted discharge of an estimated 12,000 gpm by 46 hose lines. The water spray system discharged an additional 4,776 gpm.

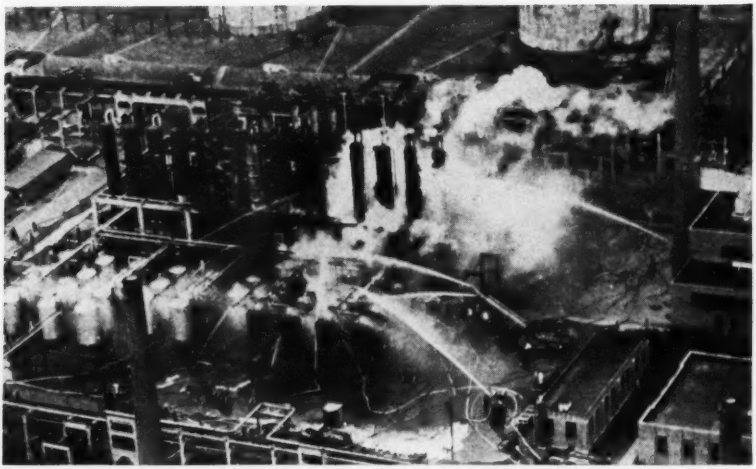
of a Director, a Supervisor, three Coordinators, and on each shift two Inspectors. The fire brigade is made-up of shift operating and maintenance personnel. A Disaster Plan for this plant which outlines emergency procedures and organization is in effect.

Description of Fire

A pump at a butadiene still located adjacent to the tank pad area had been put in service at approximately 6:00 A.M. after the packing had been adjusted and a ring of packing added. At about 7:00 A.M. a millwright noticed that a spray of butadiene was being thrown up from the region of the packing gland. He summoned an operator who immediately attempted to put the spare pump into service. Apparently, the operator opened a valve without having closed a bleeder valve which caused butadiene to flow from the bleeder valve. At this point, he attempted to close the valve in the discharge line of the leaking butadiene pump. Because he was affected by the heavy concentration of vapors he was forced to step back. A flash from the direction of the open flame heater, south of the location of the leaking butadiene pump and open bleeder valve, was observed by the operator and the millwright. Then the fire enveloped them.

The assistant shift foreman immediately opened the valve in the water spray system so that within one or two minutes water was spraying on the tanks on the pad. The compressor operator turned in the fire alarm immediately after the flash occurred which was 7:07 A.M.

The shift foreman checked the fire and found it to be such that it required a shut down of operation. He threw the emergency switch shutting down the unit by causing all motor valves connected to this



Acme

Aerial view of fire at Butadiene Unit No. 3 at Kobuta, Pa., March 6.

system to fail in the normal "on-off" position. This system was designed to block in the individual stills by closing the motor valves and to set the compressors on minimum speed. The auxiliary equipment and the adjacent butadiene unit were immediately shut down.

The 15-man shift fire brigade arrived on the scene within two minutes and attempted to control the fire using foam. The operating personnel had put some of the butadiene unit fire hose into use but the fire had now assumed extensive proportions and a large volume of butadiene venting under pressure was burning. At this time, the use of foam was abandoned and hose streams and water spray nozzles were applied. The Plant Shift Superintendent arrived on the scene with the fire brigade and assumed overall direction of handling the emergency which consisted of shutting down the unit and other sections of the main plant and process area, general guidance of fire fighting activities, arranging for outside help, and evacuating personnel from the hazardous area. The outside fire companies were called by telephone code message in accordance with the plant Disaster Plan.*

At approximately 7:30 A.M. the Supervisor of Fire and Safety arrived and direction of fire fighting operations was turned over to him by the Shift Superintendent. A few of the municipal fire departments and at least one industrial fire brigade were already in the plant and had laid a number of hose lines or were engaged in this activity. More assistance was needed and was summoned by an Assistant Plant Manager.

Upon arrival, the outside fire departments and industrial fire brigade groups were given instructions so that their efforts were immediately coordinated with the overall fire fighting activities. In the early stages of the fire the primary objective was

*Kobuta is in the industrial area west of Pittsburgh. The Disaster Plan comprised response of manpower and equipment from 19 fire departments in Beaver County, from the Pittsburgh, Pa., East Liverpool, Ohio and Chester, W. Va. departments and from several industrial fire brigades.

to protect exposures as rapidly as possible. Hose streams and sprays were directed against tanks, stills, supporting members and process piping close to the fire area. The initial attack was directed from three sides, toward the main fire area. Around 8:00 A.M. or shortly thereafter several explosions and flare-ups occurred in the fire area, probably caused by pipe lines rupturing. Hose lines were extended to the compressor and control rooms. An uninsulated copper column collapsed and leaned against the butadiene column.

At about 9:30 to 9:45 A.M. the fire was controlled. Three foam generators were set up ready for immediate use in the event of a tank rupture.

From this period on, until the final "knockout" with dry chemical fire extinguishers the strategy resolved itself into controlling the fire with the hose streams, the water spray system, and starving the fire of fuel. Operating personnel worked their way into the tank area gradually isolating equipment by closing supply and vent lines.

Forty-six 2½-inch hose lines from fire department pumpers, fire pumps, and directly from hydrants were discharged into the fire area through hand lines, deluge nozzles and the water tower (aerial ladder) at a total flow of approximately 12,000 gpm.

The water spray system on the tank pad area performed satisfactorily delivering water at the following estimated quantities:

2,172 gallons per minute, total quantity on all tanks. (59 gpm per tank.)

1,620 gallons per minute, total delivered via water curtain.

984 gallons per minute, total delivered at walkways.

4,776 gallons per minute, total quantity delivered on entire system.

Plugged orifices were observed on some of the water spray nozzles at the western end of the tank pad, but at no time did these heads completely fail to deliver water.

Observations

1. The operator and shift millwright received second degree burns of the face and hands. They were able to perform their normal duties in approximately three weeks and had no permanent disability.

2. The ignition of the butadiene vapors occurred at 7:05 A.M. probably from the open flame of a chemical heater.

3. The pump at the butadiene still is a standard type centrifugal pump on which the packing gland follower was attached by cap screws. In reviewing the initial release of vapors from this pump, it was observed that when adjusting the packing gland with the cap screw it is difficult to judge the number of threads actually engaged. Cap screws are standard equipment on the packing gland follower of some pumps and their use in this service is not generally considered hazardous. However, they could have been a contributing factor in causing the initial vapor release and have been replaced with studs and nuts.

4. The fire was confined to the east end of the distillation section and to the area around the butadiene column reflex pump on the tank pad.

5. One column was seriously damaged. This was an uninsulated copper gas scrubber which collapsed and leaned against the adjacent column.

6. 32,000 gallons of butadiene in various stages of purity were burned in the fire.

7. The strainers in the water spray system were full of gravel, etc. after 5½ hours of operation but all sprays were open and functioning until shut off after the fire was entirely extinguished.

Carbon Tetrachloride Bulbs and Bombs*

By O. J. Hodge

The National Bureau of Standards has conducted several series of tests to determine the effectiveness of bulb-type fire extinguishers using carbon tetrachloride as the extinguishing agent. The devices investigated included seven different models, of which six were designed both for hand and automatic operation. The seventh extinguisher was designed for automatic operation only. The capacities of the extinguishers ranged from 0.44 qt (14 fl oz) to 1.75 qt (56 fl oz).

Description of Devices Tested

The six extinguishers designed for both hand and automatic operation consisted essentially of a glass flask or bottle containing from 0.44 to 1.00 qt of extinguishing liquid. The extinguishers were mounted in a bracket intended to be hung on the wall or, in some cases, from the ceiling. The general character of the extinguishers is shown in Figure 1. The sketches are diagrammatic to illustrate two styles of the devices tested, but do not represent them exactly.

For hand operation, the bottle was intended to be removed from its bracket and the contents applied either by throwing the extinguisher into the fire forcibly enough to break the bottle or by sprinkling the liquid from the bottle on the fire.

For automatic operation, each of the six extinguishers was equipped with a thermostatic device intended to release the liquid when the temperature at the extinguisher reached a predetermined value. The thermostatic device was attached to the bracket or to the extinguisher itself. Two methods of release were included. One permitted the bottle to fall to the floor and break, thus discharging the liquid; the other permitted the liquid to sprinkle from the bottle while still held in the bracket.

The extinguisher intended for automatic operation only was mounted in a bracket to be hung from the ceiling and was especially designed to discharge 1.75 qt of extinguishing liquid in the form of a spray when the temperature of the air surrounding the device rose above a predetermined value.

The extinguishers included in the tests are designated by A to G, as listed in Table 1.

In all the tests of the devices designated as automatic extinguishers, the units were installed in accordance with the manufacturer's instructions.

Tests of Devices as Hand Extinguishers

By reason of the nature of the extinguishing liquid employed, devices of the carbon-tetrachloride type when used as hand extinguishers are not suitable for fires in ordinary freely burning materials such as wood, trash, and the like (Class A fires). The liquid is, however, effective for fires in highly flammable materials such as gasoline, oil, and the like (Class B fires).

As the devices tested employed an effective extinguishing medium, the question to be answered in the tests was whether they

*Reprinted from National Bureau of Standards Miscellaneous Publication 197, "Fire Tests of Bulb-Type Carbon-Tetrachloride Fire Extinguishers" issued May 8, 1951. Copies of the original text available from U. S. Government Printing Office, Washington 25, D. C. ,Price: 10 cents.)

made available (for Class B fires) a sufficient quantity of the liquid and applied it in a sufficiently effective manner to be of practical value. Therefore, to evaluate the effectiveness of the devices, they were tested in comparison with the 1-qt carbon-tetrachloride pump-gun extinguisher, which is the smallest type extinguisher of that type generally recognized as acceptable for first-aid fire protection.

For testing extinguishers of the 1-qt carbon-tetrachloride pump-gun type, certain "standard" test fires are commonly used. Among these fires are (1) a fire of 1 gal of gasoline on a 4- by 8-ft floor area, and (2) a fire of ½ gal of gasoline on a

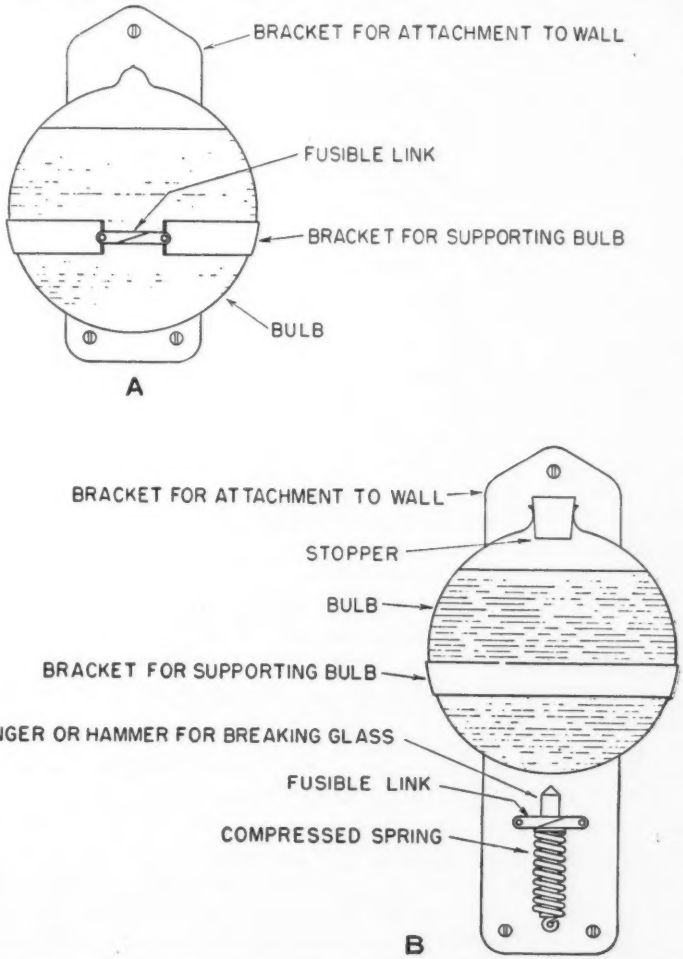


Figure 1. General character of two styles of the extinguishers tested. A, Drop-on-floor type; B, Spring-operated type.

TABLE 1. EXTINGUISHERS INCLUDED IN THE TESTS

Extinguisher designation	Amount of extinguishing liquid used		Method of operation as hand extinguisher	Temperature at which device was intended to operate when used as automatic extinguisher
	fl oz	*qt*		° *F*
A	14	0.44	Throwing	150
B	14	.44	Sprinkling	160
C	19	.59	do	160
D	24	.75	Throwing or sprinkling	158
E	27	.84	Sprinkling	160
F	32	1.00	Throwing or sprinkling	158
G	56	1.75		170

4- by 4-ft floor area. For the purpose of comparative tests of the bulb-type extinguishers with the 1-qt pump-gun extinguishers, the second, or smaller, of the two test fires was selected first. This fire can easily be extinguished by the 1-qt pump gun. When (as indicated in the test results in Table 2) it was found that none of the bulb-type extinguishers could extinguish this fire when only one unit was used, trials were made in which a number of units were applied in succession. Further trials were then made in which the area of the test fire was reduced from 4 by 4 ft (16 sq ft) to 3 by 3 ft (9 sq ft), and the quantity of gasoline from ½ gal to 1 qt. It was found by test that this fire could be extinguished with a 1-qt pump gun by the use of less than one-half of its charge. Finally, trials were made in which the area of the original test fire was reduced to a 2- by 2-ft square (4 sq ft) with 1 qt of gasoline as fuel. It was found by test that this fire could be extinguished with a 1-qt pump gun by the use of only about one-half of its charge. In the tests on the 3- by 3-ft and 2- by 2-ft-area fires, only one unit was used in each trial. Of these two fires, that on the 2-ft-sq area was the most difficult to extinguish because of the greater depth of gasoline.

The tests were conducted indoors in the Bureau's panel-furnace test building, in a room approximately 84 ft long by 36 ft wide by 30 ft high. The gasoline was confined to the specified area on the concrete floor of the room by an edging constructed of asbestos paste.

Results of Tests

The results of the tests of the devices as hand extinguishers are given in Table 2.

Summary and Discussion of Results

The tests discussed in this paper showed that the bulb-type devices when used as hand extinguishers were less effective than the 1-qt pump-gun carbon-tetrachloride extinguisher. In the first place, the capacity of the devices was, in general, too small to be practically effective and, in the second place, the manner in which the

TABLE 2. RESULTS OF TESTS OF THE DEVICES AS HAND EXTINGUISHERS.

Trial	Area of test fire	Extinguisher				Was fire extinguished?
		Designation	Capacity	Method of operation	Number of units used	
				Test 1		
	ft		*qt*			
1	4×4	A	0.44	Throwing	1	No
2	4×4	B [1]	.44	Sprinkling	1	No
3	4×4	C	.59	do	1	No
4	4×4	D	.75	do	1	No
5	4×4	E	.84	do	1	No
6	4×4	F	1.00	Throwing	1	No
				Test 2		
1	4×4	A	0.44	Throwing	5	No
2	4×4	C	.59	Sprinkling	3	Yes
3	4×4	C	.59	do	4	Yes
4	4×4	D	.75	do	2	Yes
5	4×4	D	.75	do	3	Yes
6	4×4	E	.84	do	3	Yes
7	4×4	F	1.00	Throwing	4	No
				Test 3		
1	3×3	C [2]	0.59	Sprinkling	1	No
2	3×3	C	.59	do	1	No
3	3×3	D	.75	do	1	Yes
4	3×3	D	.75	do	1	No
5	3×3	D	.75	do	1	No
6	3×3	E	.84	do	1	No
7	3×3	E	.84	do	1	No
				Test 4		
1	2×2	C [2]	0.59	Sprinkling	1	No
2	2×2	C	.59	do	1	No
3	2×2	D	.75	do	1	No
4	2×2	D	.75	do	1	No
5	2×2	E	.84	do	1	No
6	2×2	E	.84	do	1	No

[1] On account of its similarity in design to another extinguisher of larger capacity (extinguisher E), extinguisher B was tried only in the first test on the 4- by 4-ft-area fire.

[2] Due to the negative results obtained in the previous trials of the devices which were applied as hand grenades, extinguishers A and F were not tried in the tests on the 3- by 3-ft and 2- by 2-ft-area fires.

extinguishing liquid was applied made the devices less effective than the pump-gun extinguisher for the same volume of liquid used.

The first test showed that none of the devices put out a relatively simple test fire that the 1-qt pump gun can usually extinguish easily. The second test showed that to put out this test fire, more (in most cases, much more) extinguishing liquid was required. The third and fourth tests showed that even with test fires reduced in extent and severity to a point where they could be extinguished easily by not more than one-half of the full charge of a 1-qt pump-gun extinguisher, the devices did not put out the test fires except in the case of one of the units in one of three trials.

With the bulb-type extinguishers, the liquid is not as thoroughly broken up and as readily vaporized as it is with the pump-gun extinguisher, from which the liquid is forcibly projected in a relatively compact stream that changes to a fine spray when it strikes objects in the fire. Furthermore, when the liquid is applied by sprinkling from a container, it cannot be as effectively directed as it can be with the pump gun and, apparently, a considerable portion of the liquid serves to dilute the burning gasoline rather than to cause the formation of a smothering gas blanket.

In the trials in which the test fire was not extinguished, the flames were somewhat diminished during the application of the liquid, but the fuel continued to burn with the production of dense, acrid fumes in great volume. The tests were made in a room with a total volume of approximately 90,000 cu ft. When 1 qt of extinguishing liquid was applied in the manner described above, it was found that shortly afterward the fumes became so irritating that the operator was driven from the room, and they became so opaque that it was impossible to distinguish objects at distances greater than 3 or 4 ft.

Tests of Automatic Extinguishers

The tests of the devices when used as automatic extinguishers were conducted in one of the Bureau's fire-test buildings that contained a single room 29 ft long by 15 ft 3 in. wide by 10 ft 1 in. high. The walls were of brick and the floor and ceiling, concrete. A fireproof partition was erected across the building 13 ft from one end to provide a test space of 2,000 cu ft. This enclosure contained a single window 3 ft 4 in. wide by 4 ft 10 in. high, with the bottom 3 ft from the floor. It was provided with a fireproof shutter, pivoted horizontally at the center, which was so arranged that it could be set at any given inclination to give the desired ventilation. A tightly fitting door was constructed in the partition to give access to the test space. This door was kept closed when the tests were in progress. The space in the building outside of the test space contained three windows, each 3 ft 4 in. by 4 ft 10 in. and one door, all of which were kept open during the tests.

During each test, the temperature of the air surrounding the extinguishers, as well as the temperature at various other points in the test space, was measured with thermocouples. The progress of the test fires was observed by temperature measurements taken at various points in the paths of the flames.

Extinguishers A to F

According to the claims made for fire extinguishers A to F when presented for the tests, the theory of operation was that should a fire occur in the protected space

the temperature would rise and the release mechanism would cause the discharge of the carbon tetrachloride, whereupon the liquid would vaporize and be carried by the convection currents over the burning area to smother the fire with an oxygen-excluding blanket. According to this theory, these devices were intended to place a smothering gas blanket locally over a small area of burning fuel and not to provide vapor sufficient to dilute the atmosphere of the protected space to a point where combustion could no longer be possible because of the low oxygen content. This theory excluded the use of the devices for fires in ordinary combustible materials for which carbon tetrachloride when locally applied is not considered suitable, and the fires used in the tests were, therefore, confined to fires of flammable liquids (Class B fires).

Because of the danger involved in the handling of gasoline in a small room, oil rather than gasoline was used for the fuel. The oil was a mixture of two parts of light engine oil with one part of kerosene. The fuel was contained in a pan located on the floor. Fires of two sizes were used. The larger of the two consisted of 2 gal of burning fuel in a pan 3 ft sq having 6-in. sides. For the second fire, ½ gal of fuel was used in a pan 2 ft sq having 1-in. sides.

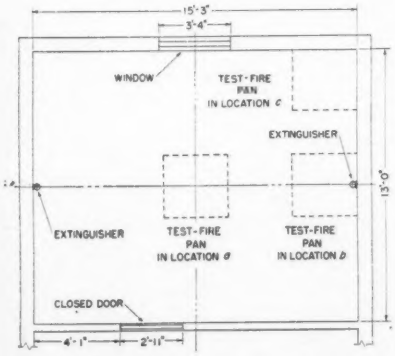


Figure 2. Plan for first series of trials of devices A to F as automatic extinguishers. Two units used; 3-foot-square test-fire pan in trials 1 to 3; 2-foot-square pan in trials 4 to 8.

The number of extinguisher units recommended by the makers was one for each 1,000 cu ft. of space protected. Accordingly, trials were first made with two units in the 2,000-cu-ft test space. Another series of trials was then made, in which the number of units was doubled.

Results of Tests

(1) *First test with two extinguisher units.* Extinguisher C was chosen for this test. As shown in Table 1, this extinguisher had a capacity intermediate between that of the smallest and the largest extinguishers in the group A to F. In each trial, the two units were mounted 5½ ft above the floor on the vertical center lines of the two end walls of the test space.

In every trial, the test fire pan was on the floor. Trials were first made with the pan at the center of the test space (location *a*), then with the pan next to one of the 13-ft walls directly under one of the two extinguishers (location *b*), and finally with the pan in a corner of the test space (location *c*). The three locations of the pan are shown in Figure 2. Location *b* is also indicated in Figure 3.

During these trials, the shutter was tilted so that the ventilation through the window, both above and below the shutter axis, was just enough to permit the fuel in the test space to burn freely. The results of the test are given in Table 3.

(2) *Second test with four extinguisher units.* The second test, in which four rather than two extinguisher units were used in each trial, was made because of the

TABLE 3. RESULTS OF TESTS OF DEVICES A TO F AS AUTOMATIC EXTINGUISHERS.

Trial	Test fire				Extinguisher				Was fire put out by the extinguisher?	Fuel consumed	Duration of fire, extinguishers present	Duration of fire, no extinguishers present
	Fuel		Area of test pan	Location of fire [1]	Designation	Capacity	Number of units used	Number of units which operated				
	Kind	Quantity										
TEST 1												
		gal	*ft*			*qt*				*Percent*	*min*	*min*
1	Oil	2	3×3	*a*	C	0.59	2	2	No	100	14	14
2	do	2	3×3	*b*	C	.59	2	2	No	100	14	14
3	do	2	3×3	*c*	C	.59	2	2	No	100	15	14
4	do	½	2×2	*a*	C	.59	2	2	No	100	12	11
5	do	½	2×2	*b*	C	.59	2	1	Yes	Less than 10	0.7	11
6	do	½	2×2	*b*	C	.59	2	1	Yes	Less than 10	.9	11
7	do	½	2×2	*c*	C	.59	2	[2] 0	No	100	14	14
8	do	½	2×2	*c*	C	.59	2	1	No	100	14	14
TEST 2												
1	Oil	2	3×3	*a*	A	0.44	4	4	No	100	14	13
2	do	2	3×3	*a*	F	1.00	4	[3] 0	No	100	13	13
3	do	2	3×3	*d*	A	0.44	4	4	No	100	15	13
4	do	2	3×3	*d*	E	.84	4	4	No	100	14	13
5	do	2	3×3	*d*	F	1.00	4	[4] 0	No	100	13	13

[1] See figure 2 for test 1, and figure 4 for test 2.

[2] The ambient temperature at 1 extinguisher was 205° to 210° F for 1½ min and at the other extinguisher, 200° to 250° F for 2½ min.

[3] The ambient temperature at the 4 extinguishers for 10 min during the test was 370° to 415° F, 255° to 310° F, 355° to 410° F, and 245° to 285° F, respectively.

[4] The ambient temperature at the 4 extinguishers for 10 min during the test was 260° to 300° F, 275° to 310° F, 315° to 355° F, and 230° to 300° F, respectively.

negative results shown in the first test. The extinguishers chosen for the second test were the following: Extinguisher A, one of the two extinguishers having the smallest capacity (0.44 qt) of those tested; extinguisher F, having the largest capacity (1.00 qt); and in one trial, extinguisher E, having an intermediate capacity (0.84 quart).

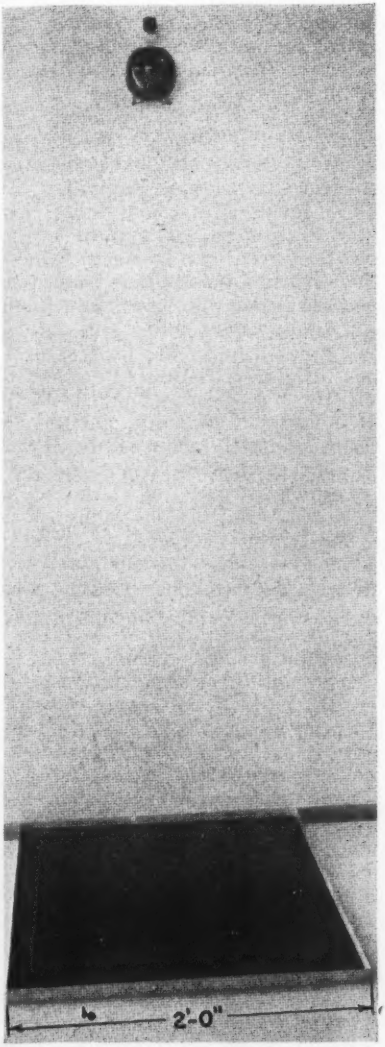


Figure 3. Trial 5, first series of tests of devices A to F as automatic extinguishers. The test pan was located directly beneath one of the extinguisher units, as shown.

In each trial of the four samples under test, two were mounted on the 15-ft 3-in. wall and two on the partition opposite. The extinguishers were mounted at a height of 5½ ft from the floor and were spaced 3 ft 10 in. from the 13-ft walls, as shown in Figure 4.

On account of the nature of the results obtained in the first test, it was not considered necessary in the second test to include all the test conditions covered in the first. Therefore, only one of the two test fires was used, the fire of 2 gal of oil and kerosene in the 3-ft-sq pan. The trials were made at location *a* with the pan on the floor at the center of the test space, and at location *d*, with the pan on the floor adjacent to one of the 13-ft walls.

During the trials, the lower half of the window in the 15-ft-3-in. wall was sealed off, and the shutter was tilted to leave an opening 40 by 20 in. in the upper half.

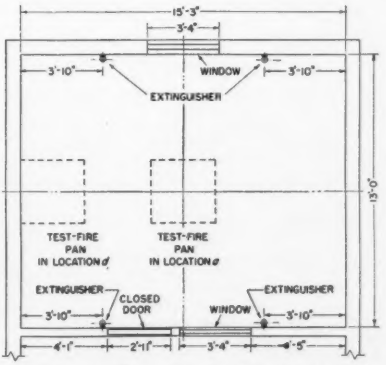


Figure 4. Plan for second series of trials of devices A to F as automatic extinguishers. Four units used; 3-foot-square test-fire pan.

Additional ventilation was provided for these tests by an opening approximately 40 by 20 in. in the fireproof partition opposite. Both openings were above the midheight of the test space, which was a condition recommended by some of the makers of the devices tested. The total area of the ventilating openings amounted to 4 per cent of the wall area above the midplane of the enclosed space. Trials with no extinguishers present showed that these openings provided just enough ventilation to permit the test fires to burn freely until the fuel was consumed. The results of these trials are given in Table 3.

Summary of Results

The tests of the devices in group A to F when used as automatic extinguishers were conducted in a room of 2,000-cu-ft capacity in which the ventilation was sufficient to permit the fires to burn freely until all the fuel was consumed. The tests showed that when two extinguisher units (extinguisher C) were used the devices were not effective in extinguishing or checking relatively simple test fires located on the floor, except when a small fire was located directly under one of the extinguishers so that all its liquid was promptly discharged into the pan of burning oil. When the units were doubled in number and located so that no extinguisher was directly above the test fire, the devices (extinguishers A, E, and F) failed to extinguish or check the fires either when they were in the center of the room or against the wall. The thermal release mechanisms of some of the units failed to operate as intended.

Extinguisher G

Extinguisher G was in the nature of an installed system that operated on the principle of diluting the atmosphere of the entire protected space to a point where combustion would no longer be possible because of the low oxygen content. The claims for this device did not exclude fires in ordinary freely burning materials, as was the case for the extinguishers in group A to F. Hence, in the tests of this extinguisher, trials were made both on fires of freely burning material (Class A fires) and fires of flammable liquid (Class B fires).

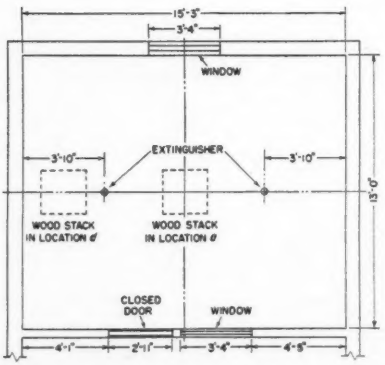


Figure 5. Plan for trials of automatic extinguisher G on wood fire. Two extinguisher units used.

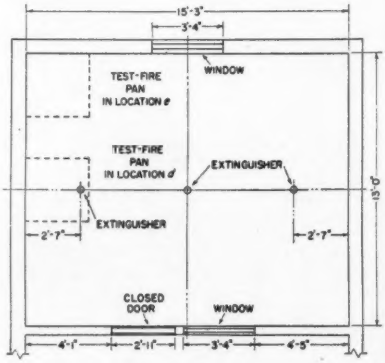


Figure 6. Plan for trials of automatic extinguisher G on oil fire on floor. Three extinguisher units used, 3-foot-square test-fire pan.

The ventilating openings in the test space were the two 40- by 20-in. windows used in the second series of trials of extinguishers A to F.

The number of extinguisher units specified by the maker for extinguishing fires in ordinary freely burning materials was one for every 1,000 ft of space protected and for putting out fires in gasoline, oil, and like materials, one for every 750 cu ft. Accordingly, in the trials on the wood fires, two extinguishers were used and in the trials on the oil fires, three extinguishers. The units were suspended from the ceiling on the longitudinal center line of the test room and were equally spaced, as shown in figures 5 and 6.

Results of Tests

(1) *First test with two extinguisher units on class A fires.* For the class A fires, one of the wood fires frequently employed as "standard" for the 2½-gal soda-and-acid hand extinguisher was used. The fuel for this fire consisted of 78 pine sticks 2 by 2 by 24 in. long. The sticks were arranged in 13 layers. They were laid parallel and about 2 in. apart in each layer. Those of each layer were laid transversely to those of the preceding layer. A cube was thus formed approximately 24 in. on the side, with air channels to afford ready combustion. The cube was built on supports 1½ ft from the floor and was ignited by ½ gal of gasoline in a pan placed 1 ft below the cube. The results of the test are given in Table 4.

(2) *Second test with three extinguisher units on class B fires.* For the class B fires, 2 or 3 gal of the mixture of two parts light engine oil and one part kerosene were used in the 3-ft-sq pan having 6-in. sides. The results of these trials are given in Table 4.

The third trial in the second test was made because it appeared probable that, since the fire in the previous trial was located directly under one of the extinguishers, the extinguishment of the fire had been accomplished by a local gas blanket rather than by dilution of the

TABLE 4. RESULTS OF TESTS OF AUTOMATIC EXTINGUISHER G (CAPACITY 1¾ QT)

Trial	Test fire				Extinguisher		Was fire put out by the extinguishers?	Fuel consumed	Duration of fire, extinguishers present	Duration [2] of fire, no extinguishers present
	Fuel		Area of test pan	Location of fire [1]	Number of units used	Number of units which operated				
	Kind	Quantity of oil								
				TEST 1						
		gal	*ft*					*Percent*	*min*	*min*
1	Wood [3]			*a*	2	2	No	100	29	29
2	do			*d*	2	2	No	100	30	29
				TEST 2						
1	Oil	2	3X3	*e*	3	[4] 2	No	100	13	13
2	do	3	3X3	*d*	3	[5] 3	Yes	40	4	22
3	Oil and wood [3]	3	3X3	*f*	3	3	No	100	[6] 23	[6] 22

[1] See figure 5 for test 1 and figures 6 and 7 for test 2.

[2] For the wood fires, this was the time when the stack collapsed.

[3] See description in text.

[4] One unit failed to operate, although the ambient temperature at the extinguisher was about 400° F for 8 min.

[5] One unit discharged only one-half its contents, although the ambient temperature at the extinguisher was 390° to 480° F for over 2 min.

[6] Duration of oil fire. Wood continued to burn.

whole atmosphere of the enclosed space. Hence, in the third trial, the same test fire was used, but the pan was placed beneath a wooden bench and about 18 in. off the floor, as shown in Figure 7.

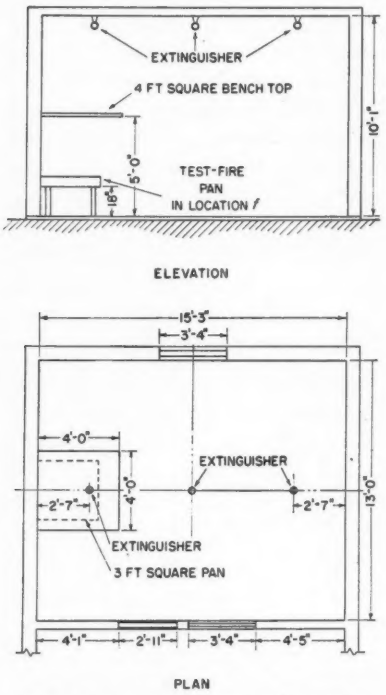


Figure 7. Plan and elevation for trial of automatic extinguisher G on oil fire in 3-foot-square pan shielded by wood bench. Three extinguisher units used.

Summary of Results

The tests of extinguisher G were conducted in the same 2,000-cu-ft room used for similar tests of the smaller extinguishers. As in those trials, sufficient ventilation was provided to permit the fires to burn freely so that they would not extinguish themselves.

As indicated in Table 4, in both of the trials with a fire of freely burning material (Class A fire) the extinguisher, when one unit was used for each 1,000 cu ft of space, failed either to extinguish or check the fire.

In the tests with the oil fires (Class B fires), in which one unit was used for each 667 cu ft, the extinguisher failed to put out or check the test fires in two of the trials and extinguished the fire in one trial. In that trial, the fire was placed directly beneath one of the units.

It appeared probable that, under the conditions of the third trial, the fire was not extinguished by dilution of the atmosphere of the enclosed space but by a local blanket effect.

Conclusions

The tests indicated clearly that when hand operated the bulb-type carbon-tetrachloride extinguisher, as represented by the samples tried, was distinctly less effective than the 1-qt pump-gun extinguisher, the smallest generally considered acceptable, principally by reason of the manner in which the liquid was applied.[1]

The bulb-type devices when employed as automatic extinguishers were not effective in protecting the enclosed space. The seven devices were tested in the number recommended by the manufacturer, and six of them were also tried in double that number.[2]

---

[1] Other types of hand extinguishers recommended for use on fires in flammable liquids (class B fires) are described in the Manual of Fire-Loss Prevention of the Federal Fire Council and the NFPA Handbook of Fire Protection, Tenth Edition. The Manual may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., at 30 cents a copy. The Handbook is published by the National Fire Protection Association, 60 Batterymarch Street, Boston 10, Mass.

[2] Water-sprinkler systems are commonly employed for the automatic protection of enclosed spaces in which the combustibles are of the usual freely burning solids. For flammable-liquid fires in enclosed spaces, automatically operated systems employing carbon dioxide or foam are sometimes installed.

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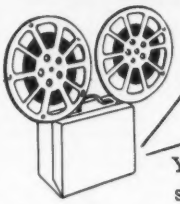

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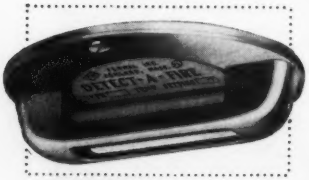

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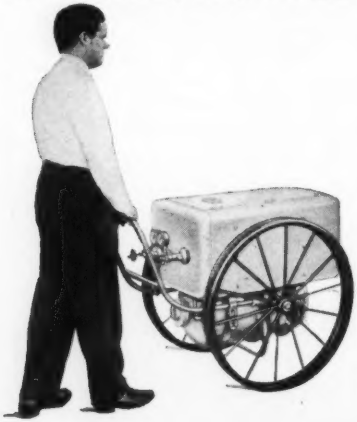

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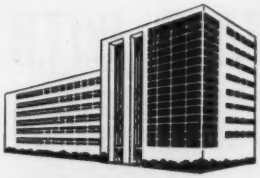

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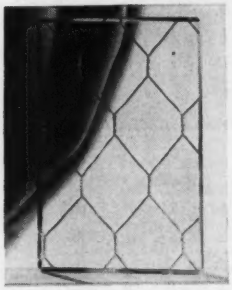

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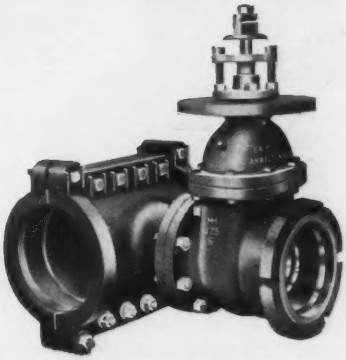

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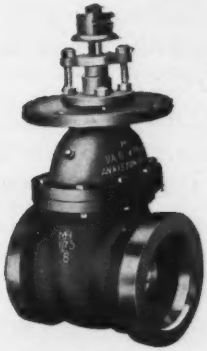

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- Ansul *"PLUS-FIFTY"*® Dry Chemical used exclusively.
- Field tested by thousands of satisfied customers.
- Ansul LT Models are the only dry chemical extinguishers listed by U.L. for operation at –65° F.

● Send for File No. 713. You will receive a variety of helpful printed matter. Included is our latest catalog which describes Ansul Extinguishers of all sizes — from the small Ansul Model 4 to Ansul Piped Systems and Ansul 2000 lb. Stationary Units.

ANSUL
CHEMICAL COMPANY
Fire Extinguisher Division
MARINETTE • WISCONSIN

DISTRIBUTORS IN ALL PRINCIPAL CITIES IN THE U. S. A., CANADA AND OTHER COUNTRIES

GRAVITY WATER SUPPLY

protects textile mill in South Carolina

This 150,000-gallon elevated steel tank maintains gravity water pressure in the automatic sprinkler system at the Gerrish-Milliken Mill at Pendleton, S. C.

The mill building, which covers an area of 180,000 sq. ft., is protected from fire by an automatic sprinkler system containing 2,245 sprinkler heads. The elevated tank, which is 100 ft. to the bottom, provides the primary water supply for the sprinkler system. The secondary supply is taken from a 450,000-gallon spray pond.

Gerrish-Milliken is the rayon division of Pacolet Manufacturing Company, Inc. It weaves nylon and filament rayon fabrics which are sold through Deering, Milliken and Company, Inc.

Write our nearest office for quotations on elevated tanks installations. State capacity, height to bottom and location.

CHICAGO BRIDGE & IRON COMPANY

CLEVELAND	CHICAGO	BIRMINGHAM	NEW YORK
HAVANA	DETROIT	ATLANTA	PHILADELPHIA
HOUSTON	TULSA	LOS ANGELES	SAN FRANCISCO
SEATTLE	BOSTON	WASHINGTON	SALT LAKE CITY

Plants at Chicago, Birmingham, Salt Lake City and Greenville, Pa.

REMEMBER!!
FIRE DANGER
NEVER TAKES A VACATION

The Fire calls the firemen. An automatic *FIRE ALARM* is a feature of GLOBE Sprinkler systems. It operates while sprinklers are extinguishing the *FIRE*. Install this system. Why depend on a passerby for a midnight *FIRE* alarm?

GLOBE AUTOMATIC SPRINKLER CO.

NEW YORK... CHICAGO... PHILADELPHIA

Offices in nearly all principal cities

THEY PAY FOR THEMSELVES

CUT DAMAGE from SMOKE ODOR

AIRKEM Smoke Odor Service now is used by practically every major fire insurance company in America—and by many fire departments—to cut smoke odor damage after a fire.

Occupants of offices and dwellings need no longer be subjected to the annoying, lingering odors of smoke.

Use of Airkem Smoke Odor Service involves no handling of the damaged merchandise or furnishings. There is no danger of soiling, spotting, bleaching, contaminating. Airkem has no flash-point and is non-explosive and non-poisonous.

At a minimum of cost Airkem Smoke Odor Service is saving millions of dollars every year.

RECENT EXAMPLES OF SAVINGS ACHIEVED

$400,000 inventory of clothing exposed to heavy smoke from fire . . . Cost of Airkem application—$493.35 . . . Estimated savings—$5-7,000. No smoke damage claim by assured.

$63,000 run of fresh cottage cheese subjected to heavy smoke from butane tank explosion fire . . . Cost of Airkem application—$165.00 . . . Estimated savings—$56,000.

$200,000 in merchandise, from fur coats to electrical appliances, exposed to dense smoke from fire . . . Cost of Airkem application—$840.00. Estimated savings—$3,000.00.

Airkem
Smoke Odor Service

AIRKEM, INC.,
241 East 44th St.,
New York 17, N.Y.

FOR FULL DETAILS SEND COUPON TODAY

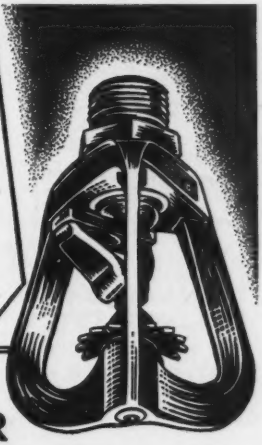
Dear Sirs: We are interested in Airkem's modern, proved technique for minimizing smoke odor damage. Please send us the facts.

NAME_____

ORGANIZATION_____

STREET_____ CITY_____ ZONE____ STATE_____

Another ROCKWOOD first



BETTER USE OF WATER FOR QUICKER FIRE EXTINGUISHMENT

Before World War II, Rockwood made water more efficient in extinguishing fire by the development of WaterFOG.

Portable WaterFOG Nozzles and Fixed Piping Installations were developed to extinguish fires in flammable liquids and materials. Then it developed that this method of breaking up water was effective in Class "A" fires (ordinary combustibles).

The High Capacity Fog Nozzle and the regular WaterFOG Nozzle were adopted by both the Navy and Municipal Fire Departments with outstanding success.

The T-Head is one further step in this development of more efficient use of water in fire extinguishment. This development will revolutionize sprinkler protection.

What is the T-HEAD!

The Rockwood T-Head is engineered and designed for use in fixed piping systems. It has a directional wide angle, medium velocity discharge and is installed in a pendent position. It is recommended for automatic as well as open deluge use.

This head can be used either as a sealed or open head. The sealed head combines the principles so successfully developed in WaterFOG with the sturdy time tested construction of the figure 4 fusible element of the regular Rockwood Sprinkler Head.

It has a full sized opening for the discharge of water. The design of the T-Head breaks up the water into a fog pattern fine enough to completely fill the area from the ceiling down to the floor and heavy enough to drive the particles down to any fire on the floor.

If the fire starts on the floor, the hot gases mushroom up in an inverted cone. The nearer the ceiling, the wider the cone. This head has a wide angle distribution without voids in the area near the ceiling. It prevents gas and flame from rising and also prevents them from mushrooming and needlessly opening adjacent heads.

The Rockwood T-Head is approved by Factory Mutual Laboratories and listed by Underwriters' Laboratories Inc.

Write today for new illustrated T-H sales folder.

The T-Head that will Revolutionize Sprinkler Protection!

ROCKWOOD

ROCKWOOD SPRINKLER CO.

56 HARLOW STREET WORCESTER 5, MASS.

Experienced Engineering • Specialized Manufacturing • Expert Installation

WHERE FIRE SAFETY IS A MUST...

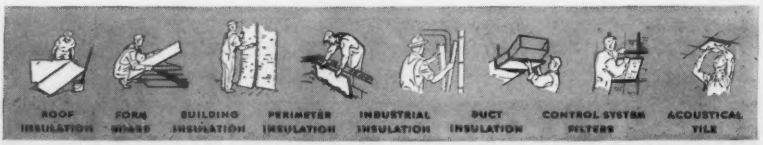
NONCOMBUSTIBLE OWENS-CORNING FIBERGLAS ACOUSTICAL TILE

. . . is specified more and more. This tile offers a unique combination of values:

- Fire Safe*
- High Acoustical Value
- Decorative Beauty
- Good Light Reflection
- Ease of Application
- Sanitary
- Cleanable, Paintable
- No Sustenance for Vermin
- Dimensional Stability
- High Insulating Value
- Low Cost

Want the whole story of Fiberglas Acoustical Tile? Ask your Fiberglas Branch Office for the QUIET booklet—or address OWENS-CORNING FIBERGLAS CORP., Dept. 117G, Toledo 1, Ohio.

*(1) Noncombustible under Federal Spec. SS-A-118a.
(2) Noncombustible under Building Codes using ASTM, E 84-50T.



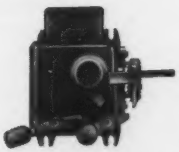
Kidde CO_2 Fire Extinguishing System Detects and Kills Fire Instantly!

Carbon dioxide is one of the fastest fire-fighters known—and here is one of the most effective uses for it . . . a *Kidde* built-in automatic system.

Increased temperature, from the first sign of fire, sets off a heat detector which automatically actuates a release connected to carbon dioxide gas cylinders. Instantly, fire-smothering CO_2 puts out the blaze . . . with no chance for human error. And, since CO_2 evaporates after doing its fire-smashing job, there's no damage to machinery or electrical equipment, and no after fire mess to ruin finishes.

Let Kidde solve *your* fire detection and protection problems. When you think of CO_2, call Kidde.

Heat Detector—Always alert, a heat detector goes into action at the first sign of fire. This one works on rate-of-rise principle, others on fixed-temperature.



Release—Actuated by the heat detector, this release causes valve mechanisms to operate letting CO_2 rush from the cylinders to the fire.

Multijet Nozzle—Kidde patented multijet nozzles decrease the CO_2 velocity without sacrificing volume—blanket flames gently, thoroughly.

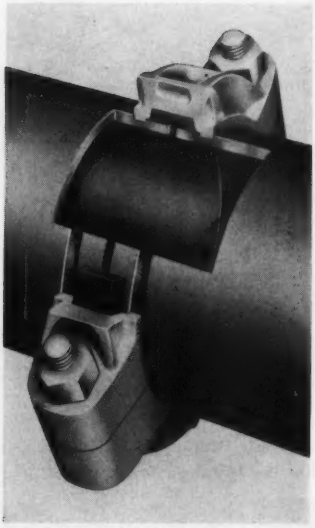
Kidde Extinguishers carry highest rating of Underwriters' Laboratories and The Factory Mutuals

Kidde

Walter Kidde & Company, Inc., 451 Main St., Belleville 9, N. J.
Walter Kidde & Company of Canada, Ltd., Montreal, P. Q.

GRUVAGRIP

Couplings for grooved pipe



Now listed by UNDERWRITERS' LABORATORIES for use on Sprinkler Systems

Famous Gruvagrip couplings for grooved pipe are now available to the fire protection industry!

Gruvagrips are made of light-but-tough malleable iron that readily absorbs shock and vibration. The flexibility, and ease with which they can be installed and dismantled, makes them ideal for use on sprinkler systems.

These time-tested couplings can be used with any standard-grooved pipe. Ask for them (in sizes 1½" - 12") at your favorite supply store.

GRUVAGRIP Couplings . . . for grooved pipe

ROLAGRIP Couplings . . . for plain-end pipe

BOTH LISTED BY UNDERWRITERS' LABORATORIES

GUSTIN-BACON MANUFACTURING CO.

1412 W. 12th ST. KANSAS CITY, MO.

Automatic Rolling Steel
FIRE DOORS *and* WINDOW SHUTTERS
PREVENT SPREAD *of* FIRE!

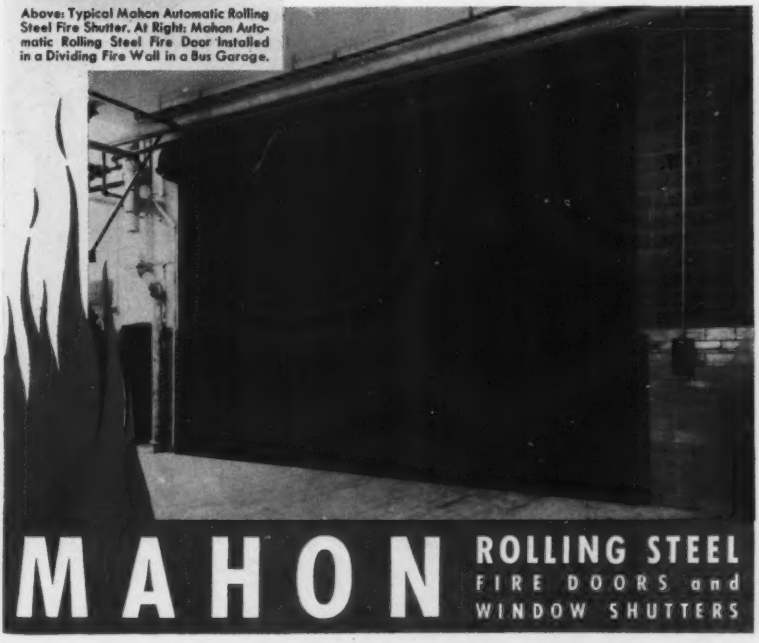
You need good automatic fire doors in fire walls, corridors, and vertical shafts . . . in some cases automatic rolling steel window shutters are necessary to protect your building and its contents from fires which may originate in nearby buildings. Many, many cases are on file which confirm that timely action of automatic rolling steel fire doors and window shutters have confined a fire to its point of origin and permitted its being extinguished with comparatively small damage. Make a survey of your building now, and don't delay action. You will find a Mahon Automatic Rolling Steel Fire Door or Window Shutter to meet each of your requirements—all bear the Underwriters' Label. These automatic fire doors may be operated manually or mechanically in every day use. If a fire should break out while they are in the open position, the automatic mechanism will close the door, cutting off drafts and preventing the spread of the fire. See Sweet's Files for complete information, or write for Catalog 652.

THE R. C. MAHON COMPANY

Detroit 34, Michigan • Chicago 4, Illinois

Manufacturers of Automatic Rolling Steel Fire Doors and Window Shutters. Also Many Types of Standard General Service Rolling Steel Doors and Grilles, Insulated Metal Walls, and Steel Deck for Roofs, Floors and Partitions.

Above: Typical Mahon Automatic Rolling Steel Fire Shutter. At Right: Mahon Automatic Rolling Steel Fire Door Installed in a Dividing Fire Wall in a Bus Garage.



MAHON ROLLING STEEL FIRE DOORS and WINDOW SHUTTERS

You know how to operate this extinguisher ... JUST BY LOOKING AT IT!

2½ and 4 lb. Models. Famous "one hand" instant operation.

Simple, ***obvious*** operation makes the Randolph really panic-proof—gets it into action ***before*** the fire spreads —kills fire instantly with a snowy cloud of CO_2! No valves to turn, no nozzles to adjust; just point and press your thumb! Randolph CO_2 is non-damaging, evaporates without a trace. It's non-toxic, won't conduct electricity, deteriorate or freeze.

25 lb. Model. Mobile defense against severe, large-area fires. One man operation.

UNDERWRITERS' APPROVED — COMPLETE LINE OF EXTINGUISHERS AND SYSTEMS. Learn how Randolph gives your plant better preventative fire protection! Write or wire:

RANDOLPH Laboratories, Inc.,
24 E. Kinzie St., Chicago 11, Ill.

15 lb. Model. Self-balanced extra range and capacity.

10 lb. Model. Long-range hose and nozzle, easily portable.

Randolph
SIMPLIFIED FIRE EQUIPMENT

APPROVED ACCEPTED... and GUARANTEED!

...The Weldwood Fire Door!

Here at last is a fire door that performs its number one function – restricting the spread of fire–yet is so handsome that it can be used in the finest interior.

The secret lies in the unique construction. The choicest of domestic and imported wood veneers are bonded to an incombustible mineral core.

The Weldwood® Fire Door is approved for Class "B" and "C" openings by Underwriters' Laboratories, Inc., and the Building Officials Conference of America.

In addition, the Weldwood Fire Door is so dimensionally stable that when properly installed, it is guaranteed not to bind or warp for the life of the installation.

Further, it is lighter in weight than other fire doors, which means that it opens and closes more easily.

No wonder Weldwood Fire Doors have the acceptance of fire officials...and are being selected for all kinds of buildings–all over the country. *(Including* the United Nations Building in New York.)

So, before you specify *any* door, be SURE to get full details about Weldwood Fire Doors. *Write today.*

WELDWOOD FIRE DOORS

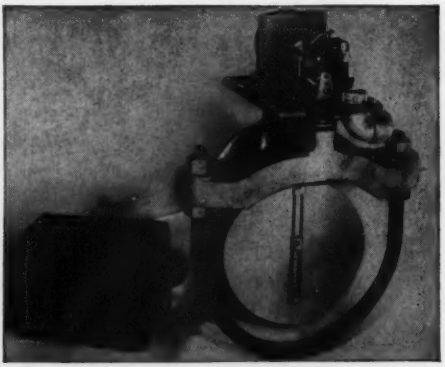
Manufactured and distributed by

UNITED STATES PLYWOOD CORPORATION

55 West 44th Street, New York 18, N. Y.

Branches in Principal Cities • Distributing Units in Chief Trading Areas

Dealers Everywhere



5-inch size shown above. To install simply drill hole in pipe.

CENTRAL STATION SIGNALS, INC. Model PRS

Waterflow Alarm Device is approved by both the Factory Mutual Laboratories and Underwriters' Laboratories, Inc. In hundreds of installations it has proved to be the ideal alarm device for sprinkler systems.

SAVE VITAL MATERIALS! Install this water flow alarm device in place of bulky alarm valves. Only 10 oz. of vital material used in our water flow switch.

- **Made in all sizes from 2½" to 8"**
- **It is positive in operation**
- **Has instantly recycling pneumatic retarding device which prevents false alarms**
- **Has enclosed electrical contacts for 15 amp, 125 volts AC and ½ amp, 125 volts DC**

By installing this most economical alarm device, you will know instantly where the water is flowing. Many plants are having them installed on each floor or in each section. They save water damage.

This device can also be obtained as Model PRT, a coded waterflow transmitter from which signals are received on a punch register and single stroke gong. Practically any number can be installed on a two-wire system, thus resulting in considerable savings on wiring.

WE SOLICIT YOUR INQUIRIES

CENTRAL STATION SIGNALS, INC.

Manufacturers of all kinds of approved devices used in Central Station Systems or Class 'A' or Class 'B' Proprietary Fire Alarm Systems, either automatic or manual.

71 WEST 23rd STREET -:- NEW YORK 10, N. Y.

YOUR OWN FIRE DEPARTMENT!

. . . a fire department that's on duty 24 hours a day, without vacations and without "pay"—safeguarding your property . . . preventing loss of life . . . protecting your profits . . . insuring employees' positions!

Your yearly insurance savings applied to the cost of a Blaw-Knox Automatic Fire Protection System converts an existing expense into a capital asset. Reductions from 50 to 90% are effected by this fully recognized fire protection—quickly amortizing the entire cost.

"LITTLE JOEY SPRINKLER"

At your request a Blaw-Knox Engineer will make a survey of your fire hazards, secure your insurance underwriter's requirements, prepare a preliminary layout of a system that will give you the utmost in fire protection, and submit an estimate of costs—all without obligation.

BLAW-KNOX SPRINKLER DIVISION
OF BLAW-KNOX CONSTRUCTION COMPANY
829 Beaver Ave., N.S., Pittsburgh 33, Pa.
Offices in Principal Cities

BLAW-KNOX FIRE PROTECTION SYSTEMS

Don't Give FIRE an opening!

FIRE TRAVELS FAST through unclosed or poorly protected doorways, windows, corridors or other openings, where flame-carrying drafts can quickly spread disaster. Block fire at these danger zones with Kinnear Rolling Fire Doors!

You get *positive, automatic, dependable* fire protection at any opening with these famous Akbar Fire Doors. They're *pushed* downward by a strong spring . . . *controlled* in downward speed by a special safety device . . . and operable *after* automatic closure, for emergency use. The doors remain coiled out of the way overhead when not in use, but lower into place with speed and efficiency when fire threatens. They cut off drafts, confining fire to small areas. Approved and labeled by Underwriters' Laboratories, they have saved as much as *one-third* of their cost *annually*, in reduced insurance rates. Built to fit openings of any size. Write for complete information.

Kinnear Rolling Fire Doors can also be equipped for daily service use, with or without motor operation. But the regular (non-labeled) Kinnear Rolling Doors are preferred for service use where extra fire protection is not required.

KINNEAR ROLLING DOORS

Serving Users in Principal Cities

The KINNEAR MFG. CO.
2250-70 Fields Avenue, Columbus 16, Ohio
1742 Yosemite Ave., San Francisco 24, Calif.
Offices and Agents in All Principal Cities

In The Background Till Fire Strikes

Fits in smoothly with the most modern interiors. Barely visible, but ready at a second's warning to spring into action. Viking Flush Type Sprinkler Heads offer great *dependability*, plus true functional design. Get all details today from the *Viking* representative in your neighborhood.

THE VIKING FLUSH TYPE SPRINKLER HEAD

VIKING CORPORATION REPRESENTATIVES

Crawford & Slaten Co.
Atlanta, Georgia

Crawford Sprinkler Co.
Charlotte, North Carolina

Hudson Viking Sprinkler Co.
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Jackson, Mississippi
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THE VIKING CORPORATION
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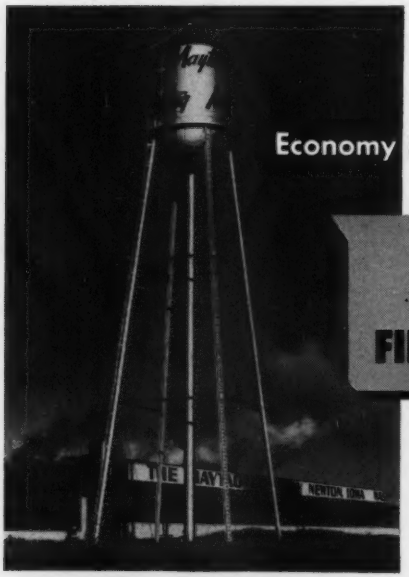


Economy in water supply

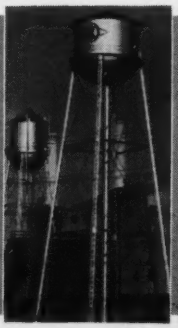
plus
Dependable
FIRE PROTECTION

PITTSBURGH
• DES MOINES

INDUSTRIAL *Elevated Steel Tanks*

Water for process use—for general plant needs—for ever-present sprinkler supply! You're *sure* of dependable water service and protection with storage in a Pittsburgh-Des Moines Tank—your satisfaction is guaranteed by the pioneer builder of elevated steel tanks since 1897. Let us quote on your requirements.

Write today for our complete Elevated Steel Tank Brochure



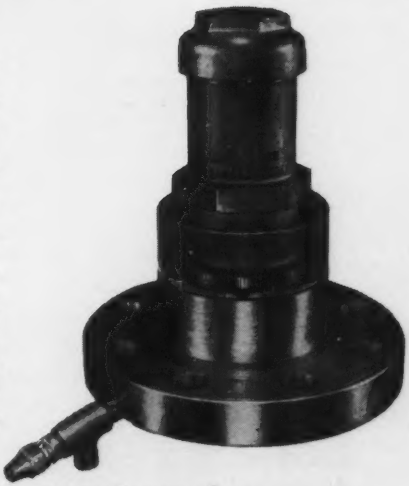
PITTSBURGH • DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

PITTSBURGH (25) . . . 3468 Neville Island
NEW YORK (7) . . Room 950, 270 Broadway
CHICAGO (3) . 1272 First National Bank Bldg.
SANTA CLARA, CAL. . 675 Alviso Road
DES MOINES (8) . . . . . 969 Tuttle Street
DALLAS (1) . . . 1273 Praetorian Building
SEATTLE . . . . . 976 Lane Street

PUTTING OUT THE FIRE



When a baseball pitcher gets into trouble, he can be yanked and a reliefer sent in to put out the fire. In handling L.P.G., however, you must have 100% protection against fire right from the start. That is why so many L.P.G. men insist on Shand & Jurs hydraulically operated Internal Safety Valves for their storage and truck tanks. They know that no accident or contiguous fire can force S&J Hydraulic Internal Safety Valves open, causing discharge of tank contents with resultant fire hazard. Don't let a chance fire or accident strike out your profits. Contact the plant or nearest branch office listed below, and find out how you can make your L.P.G. operations SAFE with S&J Hydraulic Internal Safety Valves.

S&J

Shand and Jurs Co. 8TH & CARLTON STS. • BERKELEY, CALIFORNIA

New York Chicago Houston Tulsa Los Angeles Seattle

Special construction gives PYRENE Vehicle Type Extinguishers

AT LEAST TWICE THE SERVICE LIFE

OF ORDINARY VAPORIZING LIQUID EXTINGUISHERS

Exclusive!
Vibration dampener protects pump mechanism.
Exclusive!
Tough brass linings guard valve housings.
NO. OF VIBRATIONS
(in millions)
0 4 8 12 16 20 24 28 32 36 40 44
BRAND A
BRAND B
BRAND C
PYRENE (Vehicle Type)
In vibrating machine tests, Pyrene outlasts others up to 15 to 1.

Constant vibration cuts short the life of most vaporizing liquid extinguishers installed on trucks and buses.

Not so with Pyrene* 1 qt. and 1½ qt. Vehicle Type Extinguishers. When subjected to vibration, they'll give at least twice the life of ordinary extinguishers.

A special vibration dampener holds the Pyrene pump mechanism firmly in place, protecting it against both vertical and horizontal vibration. And tough brass linings guard the valve housings in every spot where wear could occur. *No other extinguisher offers these vital added construction safeguards.*

In competitive vibrating-machine tests (the most rigorous of such tests known) a Pyrene Vehicle Type Extinguisher outlasted three other major brands by more than 2 to 1 . . . the ratio going as high as 15 to 1. (Chart shows details.) And there is not one single known instance of the Pyrene heavy-duty mechanism wearing out in actual operation.

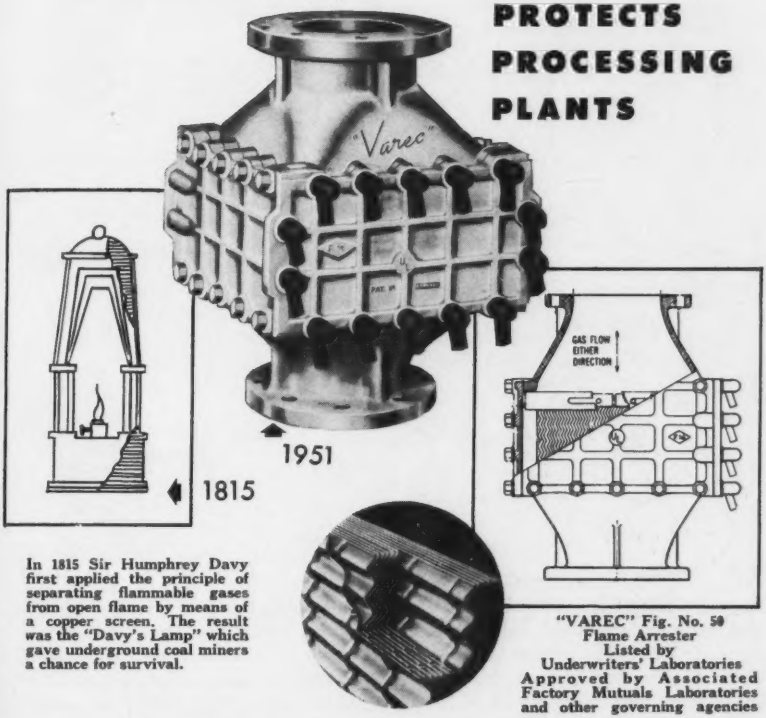
Lower price doesn't pay when you ge half the life! Buy on facts . . . buy Pyrene!

*T.M. Reg. U.S. Pat. Off.

Pyrene
U.S. PAT. OFF.
FIRE EXTINGUISHERS

PYRENE MANUFACTURING COMPANY
582 Belmont Avenue • Newark 8, N.J.
Affiliated with C-O-Two Fire Equipment Co.

THIS MODERN "Davy's Lamp" PROTECTS PROCESSING PLANTS



In 1815 Sir Humphrey Davy first applied the principle of separating flammable gases from open flame by means of a copper screen. The result was the "Davy's Lamp" which gave underground coal miners a chance for survival.

"VAREC" Fig. No. 50 Flame Arrester Listed by Underwriters' Laboratories Approved by Associated Factory Mutuals Laboratories and other governing agencies

"VAREC" FLAME ARRESTERS utilize this age-old basic principle of heat transfer in protecting plants, equipment and lives against fire and explosion wherever gas or flammable liquids are stored.

They stop burning gas in piping from rapidly propagating thus preventing fire and explosion. Heat of the flame is dissipated through the many surfaces of the multiple corrugated aluminum plates within the unit. Resultant heat loss, plus the tortuous passageways through which the flame would have to pass, stops flame propagation just as the copper screen did in the "Davy's Lamp."

"Varec" Flame Arresters are a low cost investment in the utmost safety for your plans . . . consult your "Varec" representative or write direct.

NF 2

PROVED and APPROVED "Varec"

THE VAPOR RECOVERY SYSTEMS COMPANY

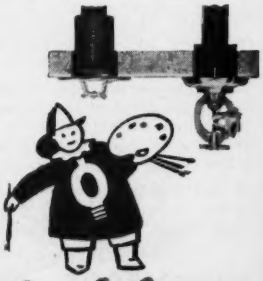
COMPTON, CALIFORNIA, U. S. A.

Cable Address: VAREC COMPTON USA (All Codes)

The development of the "Automatic 400" **Ceiling Sprinkler** discounts the adage that you can't have beauty and fire protection too. For here is a sprinkler head that is designed to blend perfectly with the appointments of the most tastefully designed interior—finished in bronze or chrome, bright or satin, it projects less than one inch below the ceiling surface. Yet, regardless of its beauty, it's ready, willing and able to automatically extinguish fire whenever called upon to do so.

You'll find the "Automatic 400" **Ceiling Sprinkler** installed in the most distinctively decorated offices, stores, restaurants and public buildings. No longer is it necessary to sacrifice "eye appeal" in order to have fire protection that offers both safety and savings.

Contact our nearest "Automatic" Sprinkler representative for engineering counsel, surveys and estimates. They are available to you without obligation. Ask for free literature.



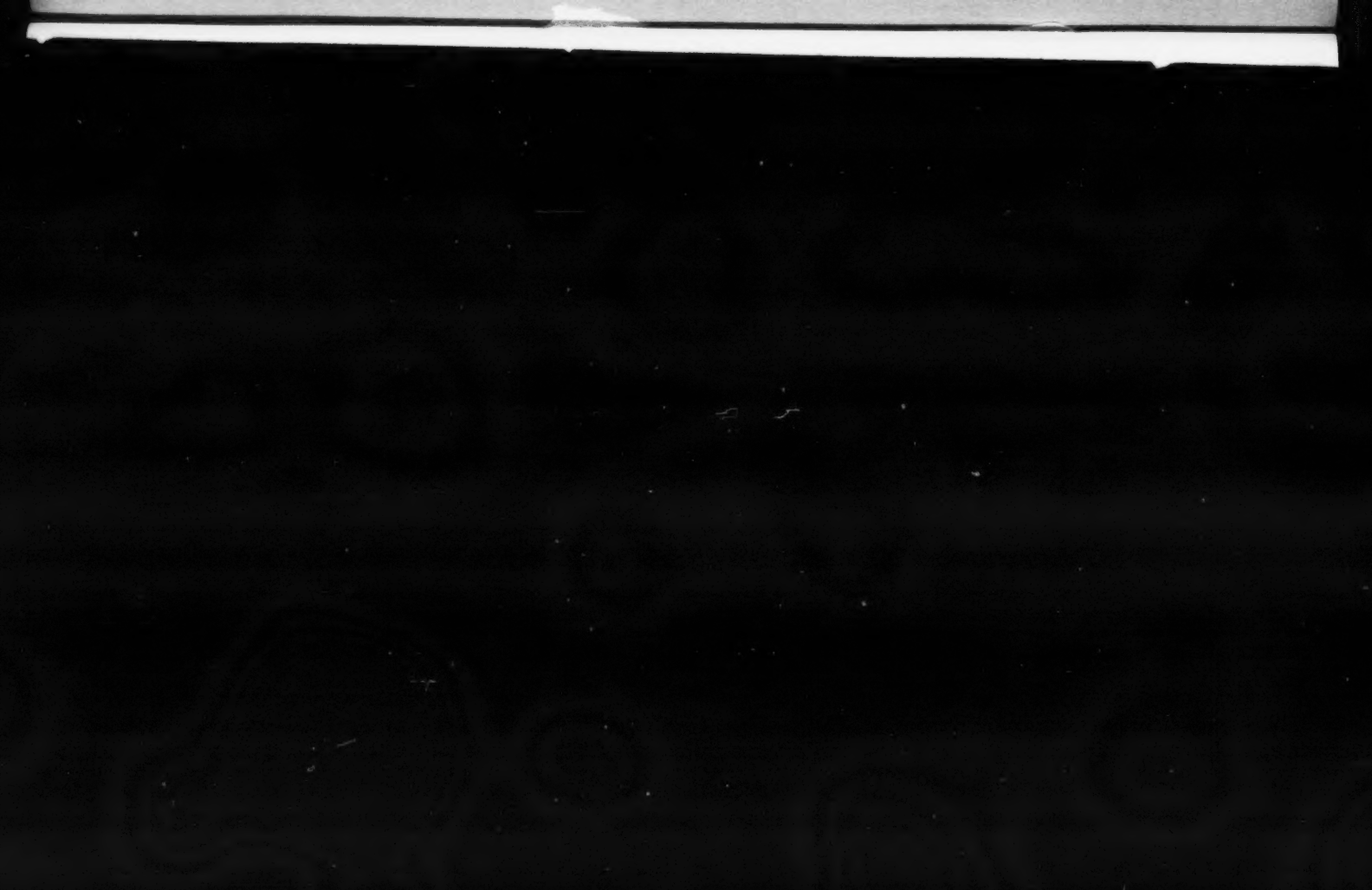
"AUTOMATIC" SPRINKLER CORPORATION OF AMERICA
YOUNGSTOWN 1, OHIO

"Automatic" Sprinkler

FIRST IN FIRE PROTECTION

DEVELOPMENT . ENGINEERING MANUFACTURE . INSTALLATION

OFFICES IN PRINCIPAL CITIES OF NORTH AND SOUTH AMERICA



GAMEWELL

Municipal Fire Alarm Systems

Until the Fire Department knows there is a fire — and the exact location— it can do nothing about it.

For the protection of the values at risk — human life, property, business and income — adequate fire alarm box distribution is a sound investment.

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GAMEWELL Three-Fold Type

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